EDISON
Electric Institute
BULLETIN

In Two Sections — Section One

JANUARY, 1935

STATISTICAL DATA OF THE ELECTRIC LIGHT AND POWER INDUSTRY

Compiled Monthly by the Edison Electric Institute—Covers 100% of the Industry

DURING THE MONTH OF NOVEMBER

	1934	1933	%
Kilowatt-hours Generated* (net)			
By Fuel	4,405,266,000	4,449,526,000	− 1.0
By Water Power	2,697,870,000	2,271,555,000	+18.8
Total Kilowatt-hours Generated	7,103,136,000	6,721,081,000	+ 5.7
Additions to Supply			
Energy Purchased from Other Sources	153,693,000	203,818,000	−24.6
Net International Imports	68,330,000	73,248,000	− 6.7
Total	222,023,000	277,066,000	−19.9
Deductions from Supply			
Energy Used in Electric Railway Departments	52,252,000	64,969,000	−19.6
Energy Used in Electric and Other Departments	112,151,000	101,605,000	+10.4
Total	164,403,000	166,574,000	− 1.3
Total Energy for Distribution	**7,160,756,000**	**6,831,573,000**	**+ 4.8**
Energy Lost in Transmission, Distribution, etc.	1,171,464,000	1,115,802,000	+ 5.0
Kilowatt-hours Sold to Ultimate Consumers	**5,989,292,000**	**5,715,771,000**	**+ 4.8**
Sales to Ultimate Consumers (kw-hrs)			
Domestic Service	1,168,382,000	1,080,510,000	+ 8.1
Commercial—Small Light and Power (Retail)	1,157,401,000	1,101,700,000	+ 5.1
Commercial—Large Light and Power (Wholesale)	2,988,809,000	2,862,335,000	+ 4.4
Municipal Street Lighting	203,388,000	196,794,000	+ 3.4
Railroads—Street and Interurban	360,936,000	352,749,000	+ 2.3
Railroads—Electrified Steam	56,388,000	58,673,000	− 3.9
Municipal and Miscellaneous	53,988,000	63,010,000	−14.3
Total Sales to Ultimate Consumers	5,989,292,000	5,715,771,000	+ 4.8
Total Revenue from Ultimate Consumers	$160,450,500	$153,979,800	+ 4.2

DURING TWELVE MONTHS ENDING NOVEMBER 30th

Kilowatt-hours Generated* (net)			
By Fuel	53,172,174,000	47,063,249,000	+13.0
By Water Power	30,796,955,000	31,622,772,000	− 2.6
Total Kilowatt-hours Generated	83,969,129,000	78,686,021,000	+ 6.7
Purchased Energy (net)	3,076,689,000	2,863,647,000	+ 7.4
Energy Used in Electric Railway and Other Departments	2,010,867,000	1,910,907,000	+ 5.2
Total Energy for Distribution	**85,034,951,000**	**79,638,761,000**	**+ 6.8**
Energy Lost in Transmission, Distribution, etc.	14,688,552,000	14,230,981,000	+ 3.2
Kilowatt-hours Sold to Ultimate Consumers	**70,346,399,000**	**65,407,780,000**	**+ 7.6**
Total Revenue from Ultimate Consumers	$1,829,366,300	$1,774,849,900	+ 3.1
Important Factor			
Per cent of Energy Generated by Waterpower	36.7%	40.2%	
Average Pounds of Coal per Kilowatt-hour	1.45#	1.45#	
Domestic Service (Residential Use)			
Average Annual Consumption per Customer (kw-hr)	629	604	+ 4.1
Average Revenue per Kw-hr (Cents)	5.31¢	5.50¢	− 3.5
Average Monthly Bill per Domestic Customer	$2.78	$2.77	+ 0.4

BASIC INFORMATION AS OF NOVEMBER 30th

Generating Capacity (kw)—Steam	23,767,000	24,053,900	
—Water Power	9,023,400	9,002,800	
—Internal Combustion	468,500	460,600	
Total Generating Capacity in Kilowatts	33,258,900	33,517,300	
Number of Customers			
Farms in Eastern Area (Included with Domestic)	(517,322)	(506,689)	
Farms in Western Area (Included with Commercial—Large)	(209,728)	(204,433)	
Domestic Service	20,473,539	19,961,895	
Commercial—Small Light and Power	3,728,106	3,690,769	
Commercial—Large Light and Power	528,528	530,301	
All Other Ultimate Consumers	69,780	66,145	
Total Ultimate Consumers	24,799,953	24,249,110	

*By courtesy of the U. S. Geological Survey with deductions for certain plants not considered Electric Light and Power Enterprises.

Vol. III, No. 1. Edison Electric Institute Bulletin; published monthly. Entered as second class matter Aug. 17, 1933, at the post office at Philadelphia, Pa., under the act of March 3, 1879. Publication office, 56th and Chestnut Sts., Philadelphia, Pa. Editorial office, 420 Lexington Ave., New York, N. Y. Subscription rate, $2.00 per year in the United States; $3.00 per year in foreign countries.

The Edison Electric Institute does not assume responsibility for, nor necessarily endorse or approve, statements made by contributors to the Bulletin.

EDISON ELECTRIC INSTITUTE BULLETIN

Volume III JANUARY, 1935 No. 1

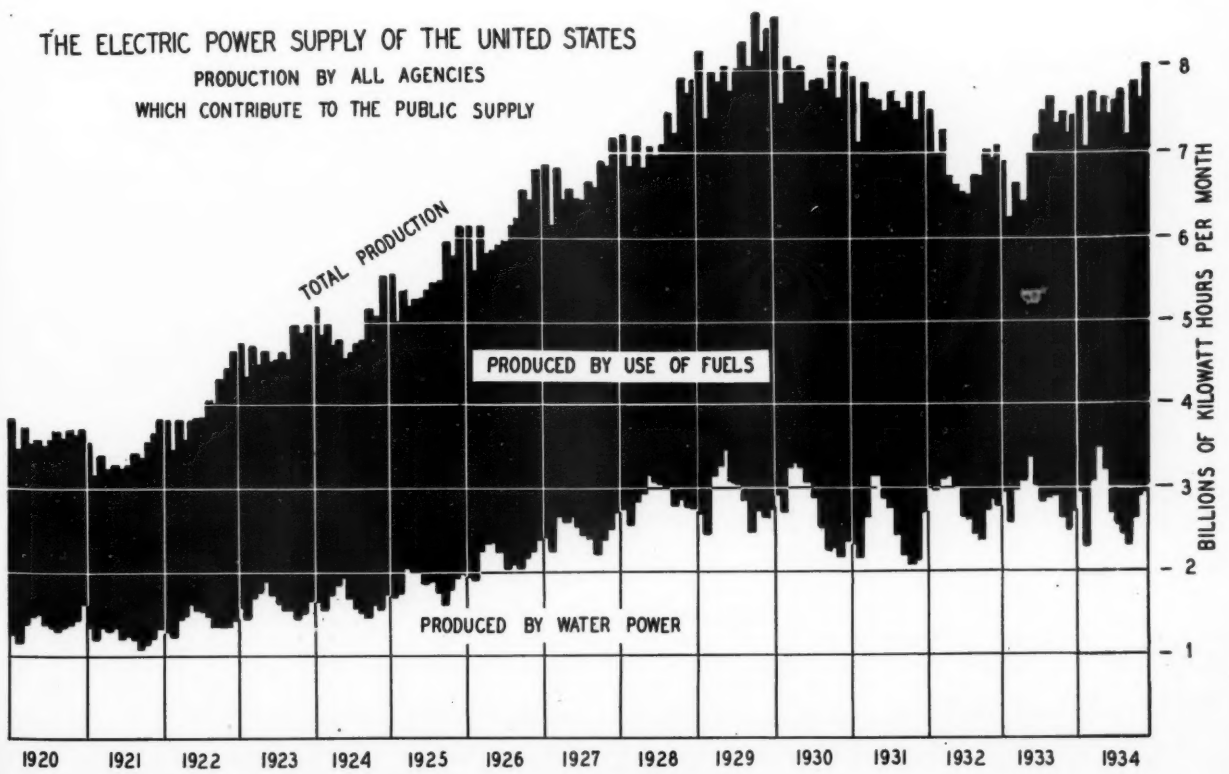
The Electric Light and Power Business at the Beginning of Another Year

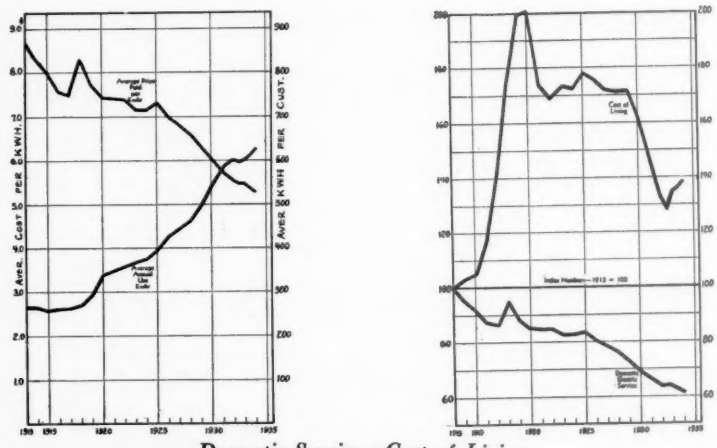
By Thomas N. McCarter
President, Edison Electric Institute

LOOKING forward to the new year, the holding of its gains by business in general and the satisfactory results of electric appliance sales campaigns are favorable factors in the prospects for the electric light and power industry in 1935. Except for the effects of the textile strike, production of electricity during 1934 remained fairly regular throughout the year at a considerably higher level than the low point of sales during the summer of 1932. Mounting taxation, pressure for rate reductions without due process of law, and the duplication of power facilities subsidized by funds from the Federal Treasury are the unfavorable factors.

During the year a new high record was set in the sale of 1,300,000 electric refrigerators and the use of lighting was stimulated by a "Better Light-Better Sight" promotional campaign. As a result, the total sales of electricity for domestic use exceeded the figures of the previous year by 6½ per cent, and set a new high record at about 12,750,000,000 kwhr. More than 500,000 families were added to the number of customers during 1934, indicating a further return to their own homes of families heretofore "doubled up."

Electricity produced in 1934 for all public purposes (including subways and traction systems) was estimated at 91,000,000,000 kwhr by the Edison Electric Institute—an increase of 6½ per cent over 1933, but still 6 per cent below the high record of 1929. Industrial power sales were up 8½ per cent, but still below 1931 and 12 per cent under 1929. Commercial sales began to reflect the increasing volume of retail trade





Domestic Service—Cost of Living

during 1934 and showed an increase of 6 per cent over the previous year. Street lighting uses were little changed from the year before, while sales of power for traction purposes increased by 8 per cent.

Total generating capacity showed a net decline. The total of 33,300,000 kw was 200,000 kw less than the year before, and this was due to the shutting down of several older and less efficient plants. Consumers, on the other hand, increased by about 500,000 to a grand total of 24,850,000 at the end of 1934. The number of farms served by utility lines showed a net increase of about 15,000.

Book value of plant and equipment approximated $12,800,000,000, as before. Gross revenues were about $1,833,000,000, an increase of $60,000,000, or 3 per cent above 1933. Rate reductions continued on much the same scale as in previous years, the average price of domestic service being reduced to 5.30c per kwhr for 1934 as a whole, as compared with 5.49c for 1933, 5.58c for 1932 and 5.78c for 1931. Prices for industrial power rose substantially during the latter half of the year as the result of the increased costs of fuel.

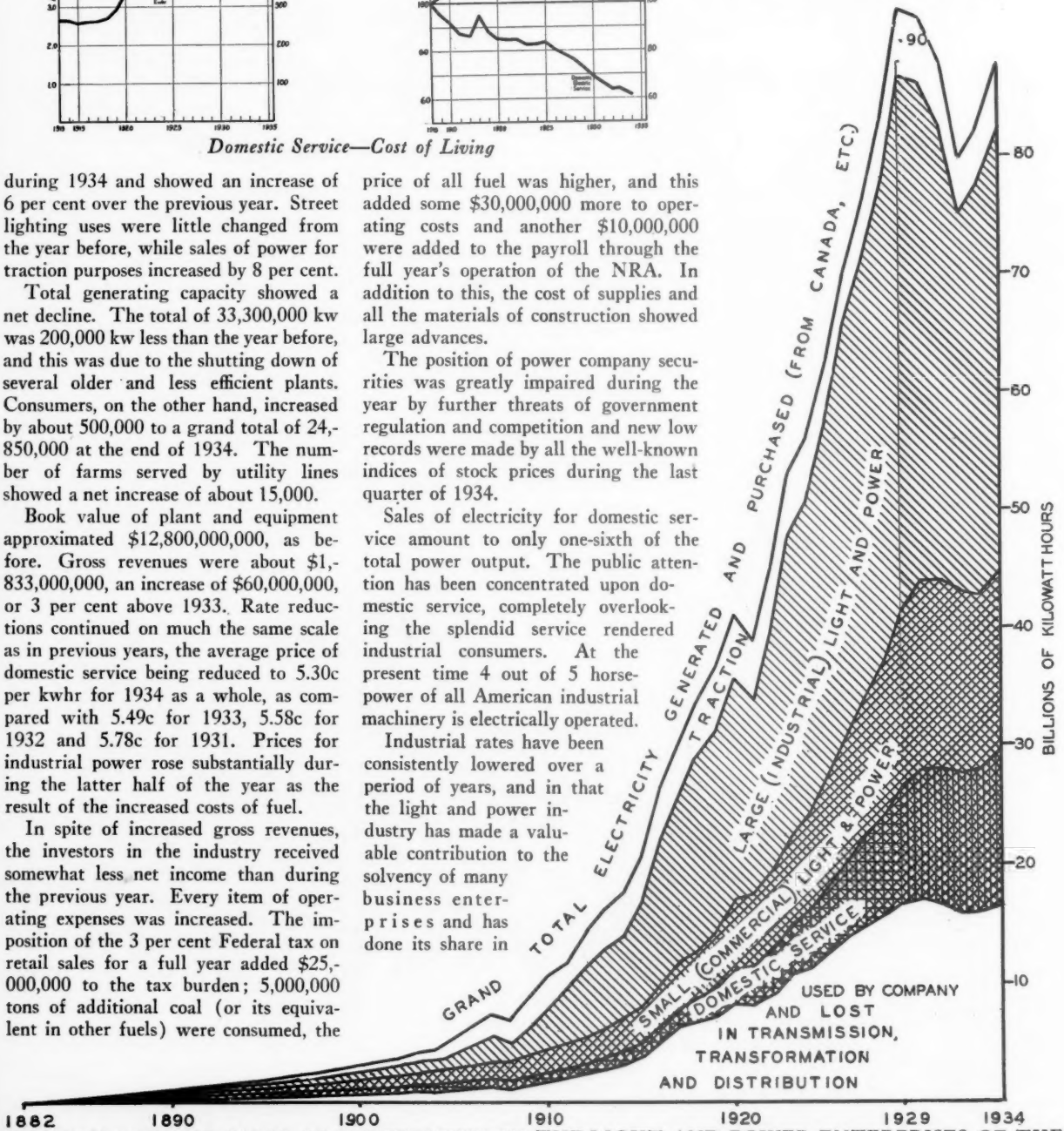
In spite of increased gross revenues, the investors in the industry received somewhat less net income than during the previous year. Every item of operating expenses was increased. The imposition of the 3 per cent Federal tax on retail sales for a full year added $25,000,000 to the tax burden; 5,000,000 tons of additional coal (or its equivalent in other fuels) were consumed, the price of all fuel was higher, and this added some $30,000,000 more to operating costs and another $10,000,000 were added to the payroll through the full year's operation of the NRA. In addition to this, the cost of supplies and all the materials of construction showed large advances.

The position of power company securities was greatly impaired during the year by further threats of government regulation and competition and new low records were made by all the well-known indices of stock prices during the last quarter of 1934.

Sales of electricity for domestic service amount to only one-sixth of the total power output. The public attention has been concentrated upon domestic service, completely overlooking the splendid service rendered industrial consumers. At the present time 4 out of 5 horsepower of all American industrial machinery is electrically operated.

Industrial rates have been consistently lowered over a period of years, and in that the light and power industry has made a valuable contribution to the solvency of many business enterprises and has done its share in lowering the costs of general industry during the present period of recovery. The sales of industrial and agricultural power total nearly 37 billion kilowatt hours, or 13 per cent more than in the active year of 1926; while the revenues from this power were only 1½ per cent more. Had the industrial power rate been on the level of 1926, the manufacturers of the United States would

(Continued on page 15)



PRODUCTION AND SALES OF ELECTRICITY BY THE LIGHT AND POWER ENTERPRISES OF THE UNITED STATES

Including, in Earlier Years, the Light and Power Departments of Street Railroads

A Memorial to the President of the United States

PRESENTED BY THOMAS N. McCARTER, ESQ., PRESIDENT OF THE EDISON ELECTRIC INSTITUTE, TO HIS EXCELLENCY, THE PRESIDENT OF THE UNITED STATES, AT WASHINGTON, DEC. 17, 1934

Dec. 17, 1934.

To the President of the United States:

I APPEAR before you as president of the Edison Electric Institute with the approval of its Board of Trustees. This organization is the trade industry representing a very large proportion of the electrical current generated in this country. I do not come in any spirit of antagonism, but I am filled with anxiety over the grave crisis which now confronts this industry, and in this state of mind I reflect the opinions of the many thousands of persons who are employed throughout the land by this industry in one capacity or another; and by a multitude of investors, who see the safety of their life savings in jeopardy.

This industry is one of the major industries of the land. Its progress during the last fifty years, starting at zero, to its present state of development, has been almost magical, and it has been one of the most substantial factors in the enormous development of the country which has taken place within that period of time. There is invested in it some twelve billions of dollars by many millions of direct investors, and indirectly by many millions more through the ownership of the securities of these properties by life insurance companies, savings banks, stock fire insurance companies, and other corporations. There is hardly any citizen of this country, possessing any qualities of thrift, who is not either directly or indirectly interested therein. The life insurance companies of the country hold approximately $1,651,000,000 of the securities of these electric companies; the savings banks and trust companies hold $2,000,000,000.

The companies composing this industry practically without exception are operating subject to thorough-going regulation by state-constituted tribunals. An overwhelming percentage of the business of the companies is intrastate as distinguished from interstate, under the definition of these respective kinds of commerce laid down by the Supreme Court of the United States. Since the coming of state regulation, which has had an average existence of approximately twenty-five years, all that these companies have sought to earn, or have been allowed to earn, is a fair return upon the capital devoted by them respectively to the service of the public. This has been the yardstick generally applied by the state tribunals, and it has only been in plain cases where this rule has not been applied that the Supreme Court of the United States has set aside rate decisions as confiscatory.

During the meteoric growth of this industry, the holding company developed as a vehicle of financing. In the main it has been a necessary and useful instrument and should continue to be so. It is true that in the period of frenzied finance and in the era of wild speculation in the years immediately preceding and ending in 1929, abuses and acts which cannot be defended crept into the manipulations of certain conspicuous holding company structures to the detriment of the public and the industry, but these were the exception and not the rule; and these abuses, except in the rarest of instances, did not involve the doings of operating companies.

Looking back upon the speculative era, we find that the follies of the day were not confined to any particular industry. The entire country lost its economic equilibrium and was off its financial balance. The nation, and the whole world too for that matter, is now paying the bill for this orgy of speculation in the serious depression which is now in its fifth year. The most extraordinary and vigorous measures are being taken and vast outlays of public money are being spent to bring the country out of this depression and to restore normal business conditions. Is it fair, or is it helpful to this great objective to single out any one industry, or any two or three industries, and visit upon it or them alone destructive punishment? Can the doubt and fear created by such a policy both within and without an industry, fail to have its effect upon the body politic at large in creating uncertainty and anxiety, with a consequent retarding effect upon general recovery? What the power of Government can do to one industry can likewise be visited upon any other form of business. No industry will be free from this devastating possibility.

The claim is made that rates, and especially rates to domestic consumers, are too high, notwithstanding the fact that throughout the country they are very generally as prescribed, after careful hearing, by state tribunals clothed with rate-making powers. Rate-making is a science and rates should be so arranged that so far as possible, each class of customers, small and large, pay the fair cost of the service rendered to them respectively. There are certain fixed costs and charges in connection with serving any customer large or small, which have to be provided for. This explains the seemingly high charges per kilowatt hour for the first small number of kilowatt hours of consumption. Even then the very small customers do not pay the cost of serving them. After these costs are absorbed, the cost of supplying increased kilowatt hours falls rapidly.

The great field for lower rates lies in increased consumption, the effect of which is to give an average low rate for all consumption. Rates cannot be uniform in different sections of the country, where conditions are radically different. Their proper fixation depends upon the size and density of the territory served; the differing costs of labor and material; the freight rates involved; the taxes imposed under different jurisdictions; and many other factors differing in various sections of the country.

It is contended that if we were to begin *de novo* with government funds, developing latent water powers or building new plants with funds furnished by the Government, either at low rates of interest or partly advanced by gift and the balance on loan at low rates of interest, electricity could be furnished to the domestic consumer cheaper than existing companies are now able to supply it; that such public properties would operate either wholly tax-free or with a minimum of taxation, and with certain other incidental advantages over privately operated companies, thus further reducing the cost. Suppose all this to be true. Is it fair? Is it just to existing investment? Is it in keeping with the declared policy of the National Recovery Act to prevent unfair competition?

Is it in the spirit of American fairplay?

The total taxes, Federal, state and local, now paid by the industry approximate $250,000,000 per annum out of a total gross revenue of over $1,800,000,000, or nearly 15 per cent of the gross. In the company over which I preside, the taxation cost is approximately one-third of the total of all operating expenses of every character, including generation, transmission, distribution and depreciation. In these days when all avenues of taxation are choked to the limit, where will substitute sources of taxation be found if this industry be destroyed?

The history of municipal operation of public utilities in this country, with the exception of a very small number of conspicuous and isolated cases, does not indicate that upon a fair comparative basis they are operated as efficiently and economically as under private operation. The contrary is the case. The steady decline in the number of such plants over a recent period of years attests the truth of this statement.

Upon the merits of the case, the facts are as follows: The average bill of the domestic consumers in this country—the total number of which class of consumers run into the millions—is substantially less than $3 per month, or $36 per year. In the particular company of whose affairs I have intimate knowledge, the average is $2.80 per month, or $33.60 per year. This is less than 10c per day; less than the cost of a package of cigarettes; less than the price of a gallon of gasoline; less than the price of a ticket to a moving picture theatre; a relative trifle in the daily life of the average citizen. It is a very small portion of the budget of the average American family. Opinions seem to differ as to just what this average income is. But whatever latitude there may be in this figure, the electric bill does not exceed 2 per cent of the budget.

Clothing, food, and the many other necessities of life run into the high percentages of the budget, which added together equal 100 per cent. It is stated on reliable authority that the taxation budget—Federal, state and municipal—of the average American family at the present time approximates $300 per year, or nearly ten times the amount of the electrical item in the budget. It would seem to me that in the face of these facts, the so-called "power issue" has been unduly magnified. If the plan of public operation with government assistance of one kind or another is generally put into effect, whatever saving could be made, if any, in the consumers' bills would certainly be offset in whole or substantial part by an increase in taxation, which all citizens must bear, and the practical effect would be a subsidy to this undertaking, the cost of which would be borne by the nation at large.

I call especial attention to the fact that there is now existing a very substantial surplus of power available for the use of the public throughout the country, and that the full development of these water power sources will create a huge excess of supply, running in some cases as high as 150 or 200 per cent in excess of any reasonable anticipated requirement. The greatest benefit that could be hoped for by the carrying out of any such plan would be the saving of a comparatively small amount each month to the consumer in the bill which he now pays—benefiting him relatively little, but in the aggregate spelling ruin and destruction to the private companies and to their investors.

I subjoin herewith, not for its legal effect but for the soundness of its economics, the following quotation from the opinion of the Supreme Court of the United States in the case of *Knoxville vs. Knoxville Water Co.*, 212 U. S. 1, p-18:

> "Our social system rests largely upon the sanctity of private property, and that State or community which seeks to invade it will soon discover the error in the disaster which follows. The slight gain to the consumer, which he would obtain from a reduction in the rates charged by public service corporations, is as nothing compared with his share in the ruin which would be brought about by denying to private property its just reward, thus unsettling values and destroying confidence."

I feel that I should direct your attention to the baneful influence of the governmental program upon at least two other major industries, viz., the railroads and the coal industry of the country. The railroads will suffer from serious losses of freight and revenue, if all the latent water powers of the country are to be immediately developed. The effect upon the coal companies is obvious. Both of these major industries are already in sore distress and the result of any such policy cannot but further injure them and further delay recovery. Furthermore, such a policy, if carried out, would necessarily add to unemployment, as it is well known that the amount of labor necessary to handle water power development is far less than that required for steam generation.

The electric industry has gone along wholeheartedly with the administration's recovery policy. It has shortened its hours of employment without diminution of wages. A large proportion of the industry is upon a five-day week of forty hours' work. If there are improper practices or abuses of any kind now being carried on, either by holding companies or by operating companies, the industry will welcome an opportunity to negotiate and arrange for their removal. Whatever the causes, the situation that now exists is one of national importance. It is bigger and broader than any particular feature of it. I am confident that if the problem is approached by representatives of all concerned, who are not extremists on the one side or the other, a solution can be found that will in a reasonable time greatly benefit the consuming public, preserve the financial and economic soundness of existing investment, and at the same time directly and indirectly put many thousands of unemployed to work in many different industries. It is respectfully submitted that more progress can be made along these lines than by governmental competition or strangulation. I pledge the industry to any co-operative effort along these lines, and I seek similar cooperation on the part of the Government.

As to the legalities: Like yourself, Sir, I am lawyer-bred, although I have not practiced for a good many years. For a considerable period of time I have been unable to shake off the conviction that the plans of the Government, as typified, for example, in the Tennessee Valley Authority experiment, were *ultra vires* of its powers and an infringement upon the sovereign rights of the states concerned. In order that I might obtain the best advice upon this subject, I submitted the problem to the Honorable Newton D. Baker of Cleveland, Ohio, and the Honorable James M. Beck of Washington, D. C., both constitutional lawyers of national reputation. These gentlemen have submitted their joint opinion, declaring this policy, to the extent contemplated, to be in violation of the Constitution of the United States. Since this opinion was received, there has been handed down by the Honorable W. I. Grubb, Federal District Judge, at Birmingham, Ala., a decision with substantially a similar conclusion, in a case pending in the United States District Court of Alabama.

(Continued on page 32)

Canada's High Domestic Consumption

How the Domestic Appliance Load Has Been Developed—Large Uses of Electricity in the Home Is a Matter of Large-Scale Cooking and Heating—Average Man Still Remains a Small User

By William M. Carpenter
Economist, Edison Electric Institute

DURING the past few months, frequent comparisons have been made between the amount of electricity used by the domestic consumer in the United States and in Canada. The high annual use of 1208 kwhr per customer for the Dominion has been unfavorably contrasted with the average figures for the United States and the differences have been painted as the results of inefficiency and extortionate rates in this country. The following information, taken from official sources, shows why domestic consumption of electricity has reached such a high state of development in certain parts of Canada.

In comparing the average use per domestic customer in Canada with the average use per domestic customer in the United States, what is largely an economic question has, for lack of correct analysis, been assumed to be one as to the relative merits of private versus government ownership. In certain areas in Canada there has been an abundance of hydroelectric power which could be harnessed comparatively cheaply, and in many of these areas the price of gas, oil and coal has been relatively more expensive than in large areas of the United States. This economic relation has made it possible in Canada to attract a much larger percentage of domestic customers to the use of electricity for cooking and water heating than has been possible generally in this country, where these two services are largely performed by coal, gas or oil.

In any comparison of electric consumption and rates in Canada with similar figures for the United States, it is important to bear in mind that the Province of Ontario is the largest single factor, and in this connection Niagara Falls constitutes one of the cheap water power sites in the world and that 80 per cent of the population of the province is concentrated in a compact area adjacent thereto.

Table 1 gives the use of domestic and farm service in Canada, as reported for 1932 by the Dominion Bureau of Statistics. Of the total sales of energy, 72 per cent are concentrated in Ontario and Manitoba and, as will presently be shown, these, in turn, are the result of the use of cooking and heating devices on a very large scale. With these two provinces eliminated, the rest of Canada shows an annual average of 653 kwhr per customer. Similar contrasts might be made in the United States.

In the Pacific Northwest in this country, conditions in this regard are somewhat comparable to those in Canada. In Tacoma, served by a municipal system, the average domestic use in 1933 was 1180 kwhr per annum. In Seattle, served largely by a municipal system, this average was 1090 kwhr, and in Spokane, served by a private company, this annual average was 1727 kwhr. The Tacoma average has been dropping during the past two or three years, due largely to the inroads of oil and slabwood for domestic heating uses, and the average use for the State of Washington has fallen about 15 per cent during the same period. In Los Angeles, however, where cheap oil and gas are abundant, the domestic customers of the municipal power and light bureau in 1933 used 580 kwhr. Jamestown, N. Y., served by a municipal plant which has had very low rates for the past several years, had, in 1933, an average use of 583 kwhr a year. It is obvious that the cooking and water heating load, not municipal ownership, accounts for very high domestic uses of electricity.

Table 2 gives the use of domestic service in the States of Idaho and Washington, where heavy-duty appliances are in considerable use, as reported for 1932 by the U. S. Bureau of the Census. The total of 1206 kwhr is almost identical with the Canadian average and compares with an average for the same year of 600 kwhr per customer for the rest of the United States.

Use of Domestic Electric Appliances in Ontario

Table 3 shows the relative number of household electric appliances per hundred

TABLE 1—DOMESTIC AND FARM ELECTRIC SERVICE IN CANADA—1932

Province	Number of Customers	Total Kwhr Sold	% of Dominion Total	Total Revenues	Annual Averages Per Customer Kwhr	Annual Averages Per Customer Bill	Average Per Kwhr
Prince Edward Island	3,978	1,498,000	0.1	$129,835	377	$32.64	8.67¢
Nova Scotia	46,421	21,213,000	1.3	1,201,279	457	25.88	5.66¢
New Brunswick	35,543	19,230,000	1.2	971,597	541	27.33	5.05¢
Quebec	385,211	239,032,000	14.6	8,210,401	621	21.31	3.43¢
Ontario	585,343	912,169,000	55.6	16,170,224	1,558	27.63	1.77¢
Manitoba	71,954	270,272,000	16.5	2,873,481	3,756	39.93	1.06¢
Saskatchewan	44,952	36,142,000	2.2	1,802,758	804	40.10	4.99¢
Alberta	57,459	29,792,000	1.8	1,714,412	518	29.84	5.75¢
British Columbia and Yukon	126,601	110,150,000	6.7	3,348,086	870	26.45	3.04¢
CANADA	1,357,462	1,639,498,000	100	$36,422,073	1,208	$26.83	2.22¢
CANADA, Exclusive of Ontario and Manitoba	700,165	457,057,000		$17,378,368	653	$24.82	3.80¢

Source: Dominion Bureau of Statistics: Central Electric Stations in Canada.

TABLE 2—DOMESTIC ELECTRIC SERVICE IN IDAHO AND WASHINGTON—1932

	Customers	Total Kwhr Sold	Total Revenues	Annual Averages Per Customer Kwhr	Annual Averages Per Customer Bill	Average Per Kwhr
Companies	247,752	296,692,279	$8,861,822	1198	$35.77	2.987¢
Municipals	123,843	151,219,944	3,876,341	1221	31.30	2.563¢
Total	371,595	447,912,223	$12,738,163	1206	$34.28	2.844¢

Source: U. S. Census "Central Electric Light & Power Stations."

NOTE: This table is not exactly parallel with the Canadian tabulation because the latter includes farms while this one does not. If the farm service (almost exclusively rendered by companies) were included, the figures for companies would be as follows: kwhr per customer 1325; annual bill $38.75; average per kwhr 2.92c and the average for all consumers in these two states would be 1302 kwhr. Note also that the difference in price level between the companies and the municipals in the above table is almost identical with the amount of taxes escaped by the municipal plants.

TABLE 3—PER CENT "SATURATION" OF VARIOUS HOUSEHOLD ELECTRIC APPLIANCES

	U S A	Ontario Municipalities			
	Dec. 1932	Dec. 1932	Dec. 1929	Dec.1926	Dec. 1924
Flatirons	95.4%	93.5%	89.9%	89.9%	89.2%
Vacuum Cleaners	46.5	26.2	22.1	21.8	18.6
Radios	66.7	48.5*	26.0*	...	...
Washing Machines	38.0	33.6	27.9	25.9	15.8
Toasters	41.0	49.5	50.4	47.0	44.1
Percolators	27.5	...	...	...	...
Ironers	3.7	1.2	0.9	0.8	0.4
Refrigerators	20.3	8.3	5.9	3.9	0.2
Electric Ranges	5.5	26.5	24.4	23.1	13.8
Electric Grills	...	10.1	11.6	10.9	13.8
Electric Hot Plates	...	13.3	10.4	9.3	5.5
Portable Heaters	16.5	31.5	36.4	36.2	30.0
Electric Grates	...	4.5	4.6	4.3	4.4
Electric Water Heaters	1.3	9.1	8.8	9.0	4.8

Sources: U. S. A. as estimated by EDISON ELECTRIC INSTITUTE (Table XIX, Statistical Bulletin No. 1). For Ontario: 1932 as given on p. 55 of the Bulletin of the Hydro Electric Power Commission of Ontario, February, 1934. Earlier years as given on p. 378 Bulletin October, 1930.

*Radio not shown in "Hydro" table; estimated from information in Canada Year Book.

customers in Ontario during recent years and a comparison is made with the United States for December, 1932. The much more liberal use of ordinary labor-saving appliances in this country is very striking. The refrigerator and the low-price radio set are the principal items which have done so much to raise the use of electricity in the average American home and in whose purchase the inherent desirability of the article—regardless of the cost of electricity—constitutes the controlling motive.

Equally striking, however, is the much greater use of electric cooking and heating devices in Ontario. The concentration of ranges is five times that of the United States and of water heaters seven times. It is this factor that causes the high average use and the low average price for current in Canada. The case of Niagara Falls, Ontario, is typical. "In Niagara Falls," stated Mr F A Gaby at the last World Power Conference*, "the domestic consumption for the year 1918 averaged 372 kwhr, whereas for 1928 an average of 3012 kwhr were consumed. The net cost varied from 2.9c. in 1918 to 1.1c. in 1928. There has been remarkable development during this ten-year period in the use of electrical appliances. For instance, in domestic service in 1918 the use of electricity was almost wholly confined to lighting. With the beginning of 1919 and following through to 1922, the first major use of the electric range took place, until it was found that in 1921 the daily peak established by ranges equalled the lighting peak created in the evening. . . . In 1922 the cooking load became greater than the evening lighting load. . . . A fact of interest is also observable about the years 1925 and 1926, when a large number of flat-rate water heaters were installed by domestic

*F. A. Gaby, Chief Engineer, Hydro Electric Power Commission of Ontario—Transactions World Power Conference Vol. 1, p. 28.

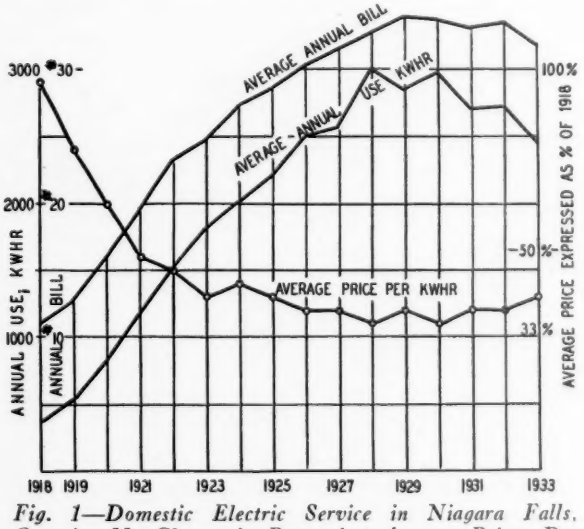


Fig. 1—Domestic Electric Service in Niagara Falls, Ontario—No Change in Rates, but Average Prices Decline by Nearly Two-Thirds.

Due to electric cooking and heating, the average annual use per customer rose from 372 in 1918 to 3012 in 1928 although the rates remained unchanged. It took ten years to build up this load. In 1931 the service charge was increased for larger appliances.

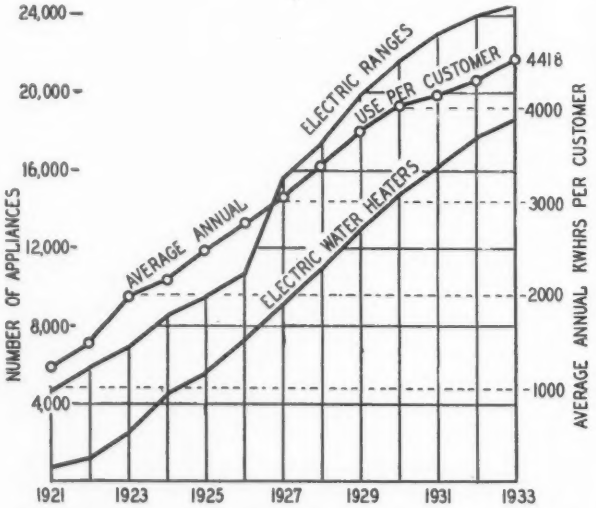


Fig. 2—Influence of Heavy-Duty Appliances on Load Building in Winnipeg.

Within the last ten years the use of electricity in Winnipeg homes has increased by nearly 400% despite an almost negligible increase in population. This has been the result of the growth of electric heating and cooking without any changes in the rate schedules.

consumers. . . . It is interesting also to note that during this period there has not been any change in the rate structure for the city of Niagara Falls, and that *the results have been brought about entirely through the increased use of appliance loads other than for lighting.*" (Italics ours.) This is graphically shown by Fig. 1.

There is a distinct parallel between the density of range installation and the average use of energy by domestic consumers of Niagara power. This is indicated by Table 4, in which the privately owned company on the New York side of the frontier, with an average of 1700 kwhr per year, makes a better showing than the Ontario average of 1649.

Electric Water Heaters

Even greater than the electric range is the effect of the electric water heater. This is strikingly evident in the sales of domestic electricity in Winnipeg, where a saturation of 46 per cent in water heaters combined with 60 per cent in ranges produced the extraordinary average of 4418 kwhr per customer for 1933 and so did much to raise the Dominion total. Fig. 2 shows the parallel between the number of these appliances and the average annual use per customer since the advent of the water heater, and Table 5 and Fig. 3 give the actual kilowatt-hours consumed in recent years. The influence of the flat-rate water heater is also indicated in Table 6, which is a summary of the annual reports of the City of London, Ontario, which, alone of all the "Hydro" cities, actually publishes detailed figures of domestic electrical use.

TABLE 4—ELECTRIC RANGE "SATURATION" AND USE OF DOMESTIC ELECTRICITY

City	Year	"Saturation" Ranges	"Saturation" Water Heaters	Kwhrs Per Year Per Customer
Windsor (a)	1928	78%	Not stated	2256
Niagara Falls, Ont	1933	64%	Not stated	2460
Toronto (b)	1932	29%	16%	1692
Total Hydro System (c)	1932	26½%	9%	1649
Niagara Falls, N Y (d)	1932	28%	Not stated	1700

(a) F. A. Gaby, Transactions World Power Conference, Vol. 1, page 26.
(b) Computed from data in the "Hydro" Bulletin, Feb., 1933, page 57.
(c) All places listed in Statement "D", 1932 Annual Report of the HEPC.
(d) Saturation as shown by "Electric Range Survey" published by Electric Light & Power, August, 1933, Kwhr from Annual Report of N. Y. Public Service Commission.

Influence of Competitive Fuels

For the most part, electricity has had an unusual advantage in Ontario and Manitoba. These provinces constitute what is always referred to by the Dominion Government as the "acute fuel area" of the Dominion. They have no coal deposits of their own and supplies of natural gas are meagre except in a few restricted localities. Except for firewood, domestic fuels must either be hauled a long way from Alberta in the west or from Nova Scotia in the east, or else imported from the United States. Anthracite has repeatedly sold at $16 per ton in Toronto and $20 in Winnipeg, and bituminous coal at $12. Cheap water power has thus been able to compete on exceptional terms and under conditions which cannot be duplicated in the United States except in a few outstanding instances. Where competitive fuels have actually been available, the progress in electric cooking and heating has, however, been greatly restricted. This is graphically shown in Fig. 4, which compares three places in Ontario

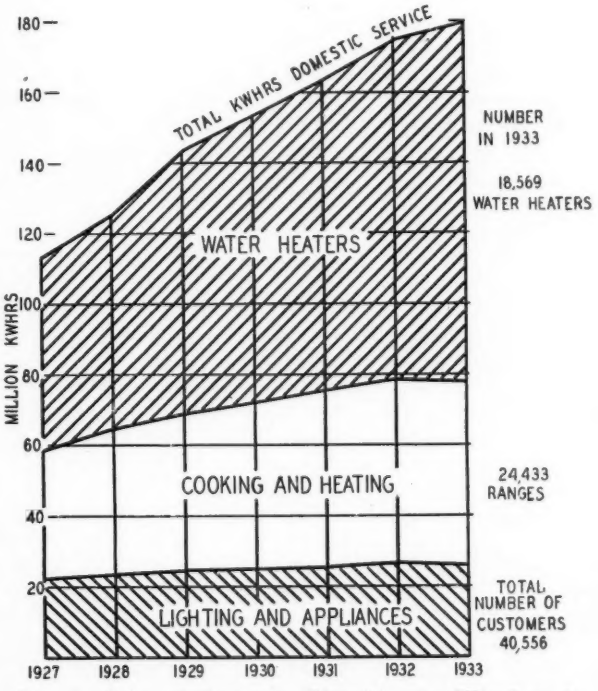


Fig. 3—Sales of Domestic Electricity in Winnipeg in Recent Years.

All of the increase has been in heavy duty heat-using appliances. In 1933 lighting and small appliances averaged only 642 kwhr per consumer, although the over-all average was 4418.

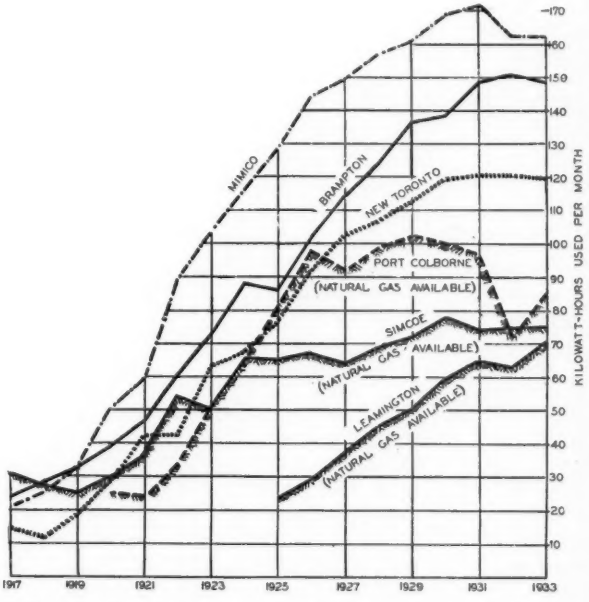


Fig. 4—Result of Competitive Fuels on Growth of Domestic Electric Service.

These six towns, served by the Ontario "Hydro" are about the same size as Tupelo, Mississippi (5000-7300 population) and have substantially the same rates. In 1933 the three places with natural gas averaged 925 kwhr per customer as compared with 1716 for the three places without it. In the case of Leamington, the gas is distributed by the town.

TABLE 5—SALES OF HOUSEHOLD ELECTRICITY BY THE CITY OF WINNIPEG

Year	Lighting & Appliances Per Customer			Heating & Cooking Per Customer			Water Heaters Per Customer			Total Domestic Service Per Customer			Saturation	
	Kwhr	Rev.	¢Kwhr	Kwhr	Rev.	¢Kwhr	Kwhr	Rev.	¢Kwhr	Kwhr	Rev.	¢Kwhr	Ranges	Water Heaters
1928	629	$15.69	2.50	2337	$23.37	0.93	5943	$24.60	0.41	3384	$32.52	0.96	46%	30%
1929	634	15.46	2.44	2249	21.33	0.95	5904	24.54	0.42	3741	34.47	0.92	50%	32%
1930	...	....	...	....	....	Not Given	....	....	...	4008	....	...	....	....
1931	632	15.35	2.43	2162	20.09	0.96	5648	23.75	0.42	4138	36.37	0.88	56%	39%
1932	660	15.72	2.38	2174	20.78	0.96	5361	22.69	0.42	4309	37.98	0.88	59%	43%
1933	642	15.47	2.41	2125	20.39	0.96	5450	21.80	0.40	4418	37.72	0.85	60%	44%

Source: Annual Reports of the City of Winnipeg Hydro-Electric System.

TABLE 6—SALES OF ELECTRICITY BY THE LONDON, ONTARIO, PUBLIC UTILITIES COMMISSION

Year	Customers			Kwhr Sold Per Year				Average Use Per Customer	Kwhr Used By Water Heaters Are % Total
	2 Wire	3 Wire	Total	1st 60 Per Mo	Excess	Flat-Rate Water Heaters	Total		
1929	9621	7380	16,548	9,561,532	15,739,840	4,061,781	29,363,153	1774	13.8%
1930	9347	7343	16,690	9,833,196	17,067,578	5,114,266	32,015,040	1918	15.9
1931	9280	7685	16,965	10,184,860	18,036,278	6,065,544	34,286,682	2021	17.7
1932	9158	7314	16,472	10,424,400	19,091,303	7,412,550	36,928,253	2242	20.0
1933	6920	9447*	16,367	10,448,162	18,908,784	9,095,016	38,451,962	2349	23.6

*1300 water heaters supplied free to consumers.

where natural gas has been in general use with three similar localities where electricity has been free from this competition. In spite of relatively low rates, domestic service has reached a "ceiling" some 44 per cent below the provincial average.

Almost 90 Per Cent of Ontario Consumers Use Less Than the Published Averages

"Averages are significant," states Morris L Cooke in "What Electricity Costs," but one should be careful to discover what that significance really is." Nowhere is this more important than in the interpretation of the high figures of Ontario and Winnipeg, which are the arithmetical result of combining a relatively small consumption by a large number of customers with a relatively large consumption by a small number of customers. The result is a mathematical abstraction which tells little of the position of the great majority of users.*

In a recent discussion of "Domestic Load Possibilities," Mr. H. C. Powell, statistician of the Toronto Hydro-Electric System,** makes the following significant observations: "A very large percentage of the domestic consumers in each municipality are using very small amounts of electricity. Some (Ontario) utilities have as many as 95 per cent who use less than 1800 kwhr per year. Though domestic service in Ontario has shown a remarkable growth in 18 years, yet the startling fact is that almost 90 per cent of the consumers use less than the published averages. Among the 10 per cent of consumers who use more than the published averages are a large number of six and seven-room houses using 12,000 to 18,000 kwhr per year, also some larger houses using considerably over 24,000 kwhr per year."

In the province of Ontario, according to published information on the number of ranges, water heaters, hot plates, grills and space heaters in use by domestic customers and according to figures on the average consumption for each such device, it is evident that approximately 70 per cent of the electricity sold for domestic use goes for water heating, cooking and space heating, and only 30 per cent goes for lighting and miscellaneous appliance use. In the United States the proportions are reversed. Only 20 per cent of the current sold to the domestic consumer goes for cooking and water heating, while 80 per cent is for lighting, refrigeration, etc.

Examples illustrating how the average use is affected by excluding cooking and water heating are to be had in the reports of the London, Ontario, "Hydro" Commission and of the city of Winnipeg. The former divides its customers as between 2-wire and 3-wire users. Presumably the 3-wire customers are those with ranges and water heaters and the 2-wire customers are the lighting and small appliance users. These latter constitute about 56 per cent of the customers, and their average use would appear to be about 575 kwhr per annum, or 48 kwhr per month. The figures for Winnipeg indicate an average use of 639 kwhr per annum for lighting and small appliances (or 53 kwhr per month) in what might be termed the most electrically-minded community in the world and one with outstandingly low rates. Low rates have not made abundant users of electricity out of a large percentage of the families which comprise these communities.

Exclude cooking and water heating and it will be found that the average use of electricity per domestic customer in the United States as a whole is about the same as it is in the Pacific Northwest, in Ontario or in the rest of Canada. Were the relation between the cost of fuel and that of generating electricity in all parts of the country as favorable to the use of electricity for domestic heating purposes as it is in the Pacific Northwest and in some parts of Canada, very nearly the same high average use would prevail throughout. In view of the sharp competition of gas, oil and coal in large sections of the United States, it is only to be expected that progress in the development of the domestic cooking and water heating load should be much slower than in these favored areas.

Even in those regions of high average use and low average prices, from one-half to two-thirds of the customers, comprising the families with lower incomes, still remain limited users of electricity and the very small users have not been stimulated by rate reductions, big or little.

*The same thing takes place in the States; see "An Analysis of Domestic Service in 1929" in the November, 1930 issue of the *N.E.L.A. Bulletin*, wherein the domestic customers are distributed according to amounts used. This subject will be treated in detail in subsquent issues of the EDISON ELECTRIC INSTITUTE BULLETIN.

**Bulletin of the Hydro Electric Power Commission of Ontario, February, 1934.

Government Competition with Electric Utilities

By Paul S. Clapp

Vice-President, Columbia Gas & Electric Corporation

An address at a meeting of the National Industrial Council and the National Association of Manufacturers, December 4, 1934

THE Federal Government has gone into the electric power business on a stupendous scale. Plans have been made and legislation will be urged at the next Congress for further large extensions. The Government has fostered, subsidized, and encouraged public operation of electric utilities by States, counties and municipalities. This still continues.

The total appropriation of Federal funds, up to Sept. 1, 1934, according to PWA reports, for Federal electric power projects and for Federal aid to State and county projects was $255,199,700. Loans and outright gifts for municipal power projects amount to $22,972,000. In addition, there has been an allotment of $1,000,000 to the Electric Home and Farm Authority and $300,000 to the Tennessee Valley Associated Cooperative, Inc. The total amount appropriated is about $280,000,000.

This appropriation of over one-quarter billion dollars is only the beginning. A total of at least three billion dollars must be spent to carry out the ultimate plans for power, navigation, irrigation, and flood control on 16 Federal projects, or Federal and State projects, already adopted or definitely being considered.

This policy of the Federal Government, directed toward public operation of the electric light and power business of the nation, is of vital concern to every citizen who believes that the principle of individual initiative and private enterprise should be conserved.

The broad question transcends that of electric rates. I believe, that unless the Federal policy with respect to the electric utilities is checked, it will have a determining influence on the future course of Government in its relation to all business. The socialization of the electric industry through public operation, by a combination of Federal, State and municipal agencies, would make such far-reaching changes in the Government's relation to business as to affect the whole pattern of government. It would open the door for Government entry into a hundred fields of endeavor

MR. CLAPP

now conducted by private citizens. If Government enters the electric business on the ground that it is a social necessity, what about food, clothes, shoes, coal, rents, housefurnishings, etc.?

Cost of Government and Electric Rates

From the standpoint of the amounts out of this income spent by the people, Mr. David Lawrence recently pointed out that taxes take $9,000,000,000; food, $7,650,000,000; rent on homes, $3,600,000,000; clothing, $3,600,000,000; automobiles, $2,900,000,000; home furnishings, $1,800,000,000. The total amount paid by domestic customers for their electric service is $650,000,000 annually, or one-fifteenth of what they pay in taxes.

Let us put it another way. Cost of all Government, which is larger than taxes, for public debt is increasing, now amounts to $550 per family per year. The average family pays $33 per year, or less than 9c per day, for electric service. Cost of Government continues to mount. During the depression, average price of domestic electric service per unit of service has decreased by 16 per cent.

Tax Exemption Would Reduce Domestic Rates 40%

Electric rates have been much discussed. By this most people mean rates for household uses of electricity. In any fair comparison between the electric rates of publicly operated and privately operated utilities, major attention must be focused on taxes. There are many other points to look at in public operation—incomplete bookkeeping, lower interest money, inadequate amortization, failure to include interest during construction, etc. Taxes alone, however, when taken fully into account will sweep away any promised savings under public operation.

This year the privately operated utility companies will pay $250,000,000 in taxes. This is the aggregate of their Federal, State, and local taxes. If these companies were made "tax exempt," as is true in large part of publicly operated utilities, and if this tax saving could be applied to reduction of domestic electric rates—the domestic electric bill of the nation could be reduced at once by 40 per cent.

Government—by this I mean all Government—Federal, State, and local, can make no greater contribution to stimulation of business recovery and decrease in living costs than by focusing attention on expenditures of Government and reduction of taxes.

Government Power Policy—Contra Recovery

The National Recovery Act, among its other objectives, declares the following:

"To eliminate unfair competitive practices."

"To promote the fullest possible utilization of the present productive capacity of industry."

The very opposite of these objectives is being followed by the Federal Government in its present policy affecting electric power. If these objectives of the National Recovery Act will stimulate business recovery, and we all believe this, is not the power policy of the Federal Government working in the wrong direction?

I have made an analysis of the excess electrical plant capacity which the Fed-

eral Government has under construction, or proposes to construct, in the southern California area, in the Northwest, and in the Tennessee Valley. These are all on the basis of power requirements for the year 1933.

A. In the southern California area, affected by Boulder Dam, existing plants had an excess generating capacity of 52 per cent. The generators to be installed at Boulder Dam in 1935 and early 1936 will raise this excess to 80 per cent. When the installations at Boulder Dam and Parker Dam are fully completed the excess will be 160 per cent.

B. In the States of Oregon and Washington, affected by Bonneville and Grand Coulee Dams, existing plants had an excess capacity of 57 per cent. The immediate Federal construction program as announced raises this excess to 109 per cent. When all generators at these two dams are installed, the excess is raised to 365 per cent.

C. In the Tennessee Basin, existing plants which included Muscle Shoals had an excess capacity over 1933 requirements of 105 per cent. Wheeler and Norris Dams will raise this excess to 160 per cent. Completion of the five-year construction program of additional dams, as proposed by TVA, would produce an excess capacity in the Basin of about 700 per cent.

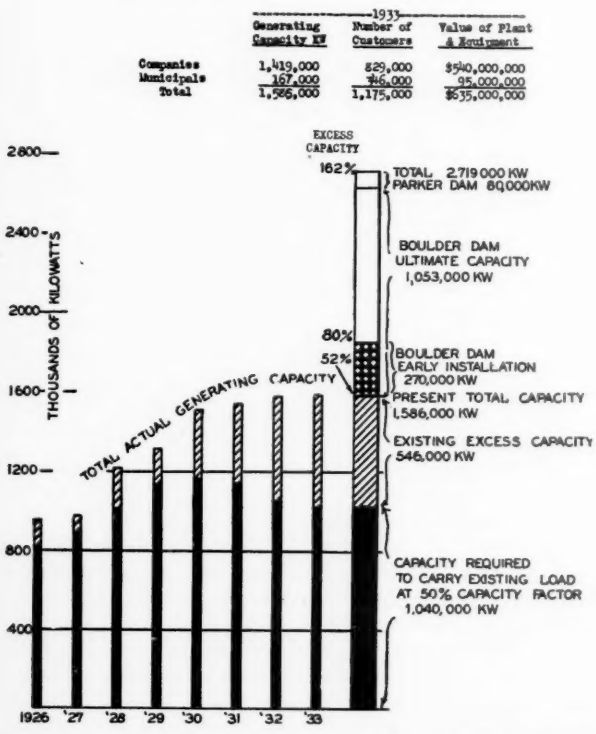
Before the Government commenced construction of Norris and Wheeler dams, the existing power houses were able to supply double present electrical demand. If the Government succeeded in doubling the consumption of electricity throughout the entire Valley, and this is a most optimistic expectation, generating plants now in operation would be able to meet the requirements without building a single new generating plant. These two dams increase the capacity to over two and one-half times that needed today. Construction of Norris and Wheeler dams, to say nothing of additional dams, is both an unwarranted overexpansion of facilities and an unproductive investment of taxpayers' money.

Construction Programs and Recovery

In December, 1929, President Hoover encouraged the railroads, industrialists, and utilities to undertake large programs of new construction in order to stem the tide of increasing unemployment and in the confident belief that the depression could be largely averted.

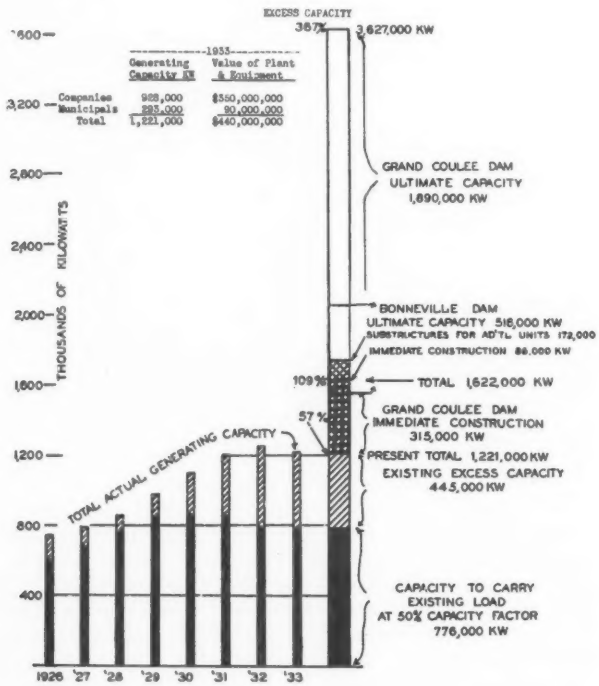
Executives of electric light and power utility companies at a White House conference committed themselves to complete cooperation with this program. During 1930 the electric companies spent over $950,000,000 in construction of new power houses, transmission and other facilities. Here was a stupendous building program—nearly one-third as large as the total PWA appropriation—carried out, not by Government, but by private enterprise. Hundreds of thousands of men were continued on their jobs in mines, factories, on railroads, and at points of construction. The durable goods industries were enormously benefited. This program was carried out in the face of falling off of business. Increases in plant capacity were made, although available plant was being utilized less each day. This is a measure of the cooperation which the electric power industry extended to the Government to assist in business recovery. They were willing to make these expansions in plant,

Electric Power Plants in Southern California (Including San Joaquin Light and Power Corp.)



Note: Total output for 1933 of the existing generating plants was 4,550,000,000 kwhr. Their output if operating with an average load equal to 50% of capacity would be 6,942,000,000 kwhr, giving an excess of 2,392,000,000 kwhr or 52%. The total 2,719,000 kw of generating capacity represents an excess of 162%.

Electric Power Plants in Oregon and Washington



Note: Total output for 1933 of the existing generating plants was 3,403,000,000 kwhr. Their output if operating with an average load equal to 50% of capacity would be 5,347,000,000 kwhr, giving an excess of present capacity of 1,944,000,000 kwhr or 57%. The immediate construction program at Grand Coulee and Bonneville raises this excess of generating capacity to 109% and the ultimate program raises it to 367%.

confident in the future electrical progress of the nation. They could not have foreseen the terrific competition from Government itself.

Absorption of the present excess plant capacity of privately operated utilities in order that they may again commence construction activity is of major importance in any program for business recovery. Construction expenditures by these utilities amounted to $129,000,000 in 1933. The estimate for 1934 is $100,000,000. The yearly average construction expenditure was $750,000,000 in the 10-year period from 1922 to 1932. These expenditures for a long period of time have been a very important factor in the durable goods market where unemployment is now the largest. The burden of added excess capacities being created by Federal funds is seriously retarding recovery in the electric utility field, and will delay the resumption of utility construction programs which can contribute greatly to improvement of business.

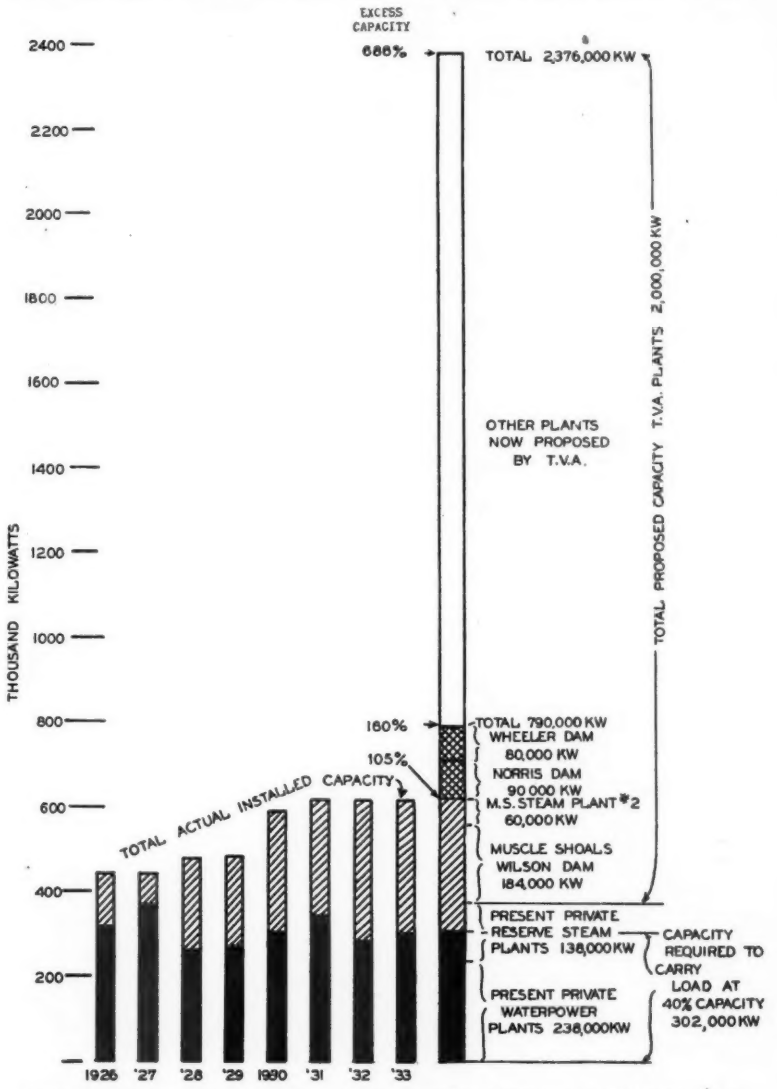
Hydro Power not Cheapest Service

That hydroelectric electricity is cheaper than electricity generated from coal was not determined by the Government before they launched into this wholesale program of building hydroelectric dams. Thoroughly competent engineering studies, by previous Government authorities, have determined that electricity can be generated in the Tennessee Valley cheaper from coal than from water. Engineers in the California and Northwest areas publicly announced that generation of electricity from fuels is now their most economical source of electric supply.

Enormous engineering progress has been made in recent years in the art of electric power production by fuels. Operating costs have been terrifically reduced. Steam power houses require less investment per kilowatt of capacity; they can be initially built to more nearly meet immediate requirements, and readily expanded as demand increases. They are located at points close to the load, and do not require long and expensive transmission lines to get the power to market. And cost of power delivered at the customer's premises is what must be considered.

Sweeping aside the questions of the soundness of the Government going into the power business; of the policy of its needlessly duplicating existing facilities—it has not determined that its method of power production is the most economical.

Electric Power Production in the Drainage Area of the Tennessee Valley



Note: Total output for 1933 of the existing generating plants was 1,058,000,000 kwhr. Their output if operating with an average load of 40% of capacity would be 2,170,000,000 kwhr, an excess of 1,112,000,000 kwhr or 105%. The two dams under construction on the Tennessee River raise this excess generating capacity to 160%; and the total of 2,376,000 kw raises it to 686%. This area is also supplied from adjoining areas in which there is also a large excess capacity of the privately owned electric companies.

Fallacy of "Yard Stick"

The avowed purpose of the Federal Government in entering the electric power business is to set up national "yard sticks" which can be measures of what electric rates should be when the service is furnished by private companies. In the Tennessee Valley, and to some extent in other sections, the power program is a part only of a broader social program, which carries with it the stern reality of Government entry into a wide variety of business and industrial enterprises.

The real necessity for the Federal Government to go into the electric business in order to determine what fair rates for service shall be, can be seriously challenged. Anyone at all familiar with the work of the State regulatory commissions and their staffs and regulation by municipalities, has high respect for the vigilance they exercise in safeguarding the public interest. All the elements of cost in rendering electric service are matters of public record. If public relation has failed, how can the much more difficult job of public operation succeed?

Now as for this "yard stick" idea. It has a terrific appeal. What could be fairer than for the Government to conduct a laboratory experiment in power operation and determine for all the citizens just what electric rates should be? The flaw in the idea is that the Government will measure with a "rubber yard stick." The costs—all of the costs—which a privately operated utility must incur will not be in the Government's "yard stick." As an example of the possibilities—most of the Federal power projects involve some combination of hydroelectric power, navigation, irrigation or flood control. Here is a great flexible area in which that part of overall cost of the project which is allocated to electric power can be raised or lowered at the will of the Government. At once we have a sliding yard stick.

In the TVA operations we have an example of the Government's "rubber yard stick" in action. Here are some facts recently stated by Mr. Wendell L. Willkie, president of the Commonwealth and Southern Corporation:

"1. The Muscle Shoals hydro and steam plants cost $60,000,000 and are said to be put on the books of the TVA at $25,000,000. The hydro plant was built in a low-cost period.

"2. The TVA pays as its sole taxes 5 per cent of the wholesale price of electric energy which is about 4 mills per Kwh. The power companies in the area are paying in taxes between 15 per cent and 20 per cent of the retail price of electric energy or 15 per cent to 20 per cent on about 2c per Kwh.

"3. The TVA is financed at low interest rates, based on all 'the income and all the property of every man, woman and child in the United States, for such is the lien of Federal borrowings.'

"4. The overhead expenses, interest during construction, etc., are not charged against the projects.

"In addition, the TVA franks all its bills, letters, advertising matter, etc., and all freight hauled for the building of the project is hauled at not to exceed 66 2/3 per cent of the freight cost to a private company."

Mr. Willkie then concluded with this highly important statement, "Given the same subsidies, we can immediately put into effect rates below the TVA rates."

Cooperation with NRA

The electric power industry has cooperated fully with the NRA program. Since August, 1933, over 22,000 additional employees have been put to work. Payrolls have been increased by about $40 million annually. The increased prices of fuel, materials, and supplies, etc., following adoption of codes by other industries, have added to operating expenses. No increases in prices of electricity have followed. The prices for electric service are regulated by State Commissions and municipalities. On the contrary, as I have previously pointed out, electric rates generally throughout the country have been sharply reduced during the depression.

Millions of Investors Affected

This policy of the Government does not concern a few rich men. It affects the investment interests of literally millions of citizens. Best information available shows that at least 3,000,000 individuals, in all walks of life, are investors in the electric light and power industry. Many more millions are directly affected through investments of insurance companies, savings banks, trust funds, endowment funds, etc. It is money representing the savings of almost literally all of the people which has built the electric industry. It is their investments which are injured by the Government's power policy.

I will repeat what I said at the outset. This policy of Government transcends the question of electric rates. It transcends the interests of the electric industry—its investors, customers, and employees. It affects all business. It strikes at the very vitals of Government.

Cat, Cold, Part of Sunday Fun for Lineman

(From the Pullman, Wash., Herald of Dec. 28, 1934)

ACCORDING to J. D. Lewis, local representative of the Washington Water Power Company, a utility position is almost a 24-hour job. No Sunday or holiday goes by without a call coming in for some sort of service. After regular hours, or long before opening time, the residence phone rings—somebody's light is out, some one has just moved in and wants service. But other jobs do come up and they are glad to do them because after years of public service there is a certain expectation, waiting for the usual or unusual to happen, it is always with them; and then it's nice to receive the approbation, the thanks and gratitude most every one gives them. But here is J. D.'s own version of a true story that happened just recently:

"I was lounging in a soft, easy chair, just reading and taking it easy, enjoying a quiet Sunday afternoon, when the telephone rang. Before I could finish my 'hello,' a voice broke in excitedly. 'This is Doctor Thayer, Farmer Thayer, out south of town. Is it possible to get a lineman to come out here and rescue our cat?' You could tell by the concern and intentness of his voice that it must be a family pet. And he went on. 'He is on top of the highest pole in the field. He must have been there since Thursday. We've looked all over for him and did not locate him till a few hours ago. We have been trying and trying to coax him down. Can you send some one out? We'll pay for it; we hate to bother you on Sunday,' and his anxiety seemed to be greatly relieved as I assured him that we would round up one of the boys and rescue the cat.

"The snow, a sort of sleet, fell regularly and the wind blew in gusts as Jack Bevens, one of our men, climbed the pole. It was a high one back in the field and as I watched him going up I thought—suppose the cat scratched him badly or as he struggled to catch him Jack got into the high voltage—and I worried worse than a woman because he was a valuable man, had been with us a long time, and, besides, this was not one of our regular jobs. What would the safety engineer say if anything should happen?

As he got his belt around the pole close to the cross arm, the cat crept out to the far end of the arm, crying with a noise in every particular like a baby. Then he turned and came toward the pole viciously and Jack grabbed him. He clawed some, but could not penetrate the heavy gauntlet leather gloves and canvas coat. Jack says he quieted down and snuggled up to his side, shivering and wet, as he climbed down the pole.

"When he handed the big Persian pussy over to Farmer Thayer, the good doctor's pleasure knew no bounds and he wanted to pay for the work, but Jack wouldn't take anything.

" 'Aw, that's all right. I wasn't doing anything and if it's all right with the company it's okay with me. You don't owe me anything.'

"And like the good sport and splendid type of young man he is, Jack laughed and thought it was a sort of interesting experience."

Addendum—And on Christmas Day there came to Jack from the grateful Thayer family and the rescued kitty a sincere yuletide greeting, with a piece of currency attached.

Making Rural Electrification Pay

By G. C. Neff

President, Wisconsin Light & Power Company

From an address before Rural Electrification Short Course at Purdue University, Oct. 19-20, 1934.

RURAL electrification means electricity and lots of it, efficiently working on the farms of our country. The extending of electric lines to the farms of this nation does not mean rural electrification. A haphazard use of electricity on the farm does not mean rural electrification. In this work we are bringing a new form of power to a great industry and we must first determine how to apply that power efficiently and intelligently. We must then see to it that this new form of power is so applied. If we do this we are building on a solid foundation and the development will have permanence.

I am also old fashioned enough to believe that another essential requirement is that both the farmer and the utility which serves him must make a reasonable profit from rural electrification or the development will fail. Here is an economic problem involving both the farmer and the utility and can only be satisfactorily worked out by representatives of the farmer and the utility working together.

Electric lines must be designed to give safe, adequate and satisfactory service with as low cost as possible. Electricity must be applied so as to give satisfactory farm operation, but in such a manner as to hold down to a minimum the cost of supplying such service. Surely the results of such cooperation will bring benefits to both the farming and utility industry and are, therefore, desirable. In fact, neither the farming industry nor the utility industry working independent of each other can bring about satisfactory rural electrification. Suppose that the backfield and the line did not work together in tomorrow's football game, but each worked out their own plan of attack independent of the other. The result would be a poor football game and defeat for the team that tried such a plan. There is just as much chance for a football team to win a game with each player following his own ideas, thinking only of himself as there is for real rural electrification to succeed without intelligent and helpful cooperation between the two principals; namely, the farmer and the utility who are on opposite ends of the same line.

MR. NEFF

The universities of the country can do much in bringing about this necessary cooperation between the producer and the consumer of farm electricity to the end that satisfactory and adequate service can be supplied at minimum cost, but at a profit to both the producer and the consumer.

I, therefore, recommend that you expand your utility committee, which has been cooperating so effectively with the university, to include some farm leaders who are interested in this development. With such a committee composed of farmers, utility men, and men from the university working together on the problems of the development of rural electrification, costly mistakes will be avoided, greater profitable use of the service will be made by the farmer, the cost of the service will be lower, and rural electrification will move forward on a sound basis. I hope every state in this United States will set up such a committee. To me this kind of cooperation seems absolutely necessary.

Value Not Price Is Test

The question is often raised, "Can farmers afford electric service?" If they want electricity for lighting only it may be that they cannot afford it, but if the farmer will properly apply electric service to his farm operations there is no question in my mind but what he can afford to pay for it. The test is a comparison of the value of the service with the bill for such service. The size of the bill has nothing to do with the question so long as the value of the service to the farmer exceeds the amount of the bill. Some people look only at the size of the bill and forget the equally important part; namely, the value of the service bought.

If farmers are convinced that a service is valuable to them, they do not hesitate to pay the bill. The most outstanding example of this is the automobile. In the 1920 census, 1,979,554 farms, which was about 31 per cent of all farms in the United States, reported 2,146,352 passenger automobiles. In 1930, 3,650,003 farms or 58 per cent of all farms reported automobiles. The total number was 4,134,675. The increase in the total number was about 93 per cent in ten years. The 1930 figures for Indiana were 154,556 automobiles on farms or 851 for every 1000 farms in the state. In Wisconsin there were 176,764 cars, which is 972 for every 1000 farms.

In Wisconsin thousands of questionnaires indicate that farmers drive on the average of 5131 miles and use 357 gallons of gasoline a year. This checks closely with a Wisconsin Department of Markets estimate of one gallon of gasoline per day for farmers' cars. According to Wisconsin Agricultural Statistics Bulletin No. 140, the life of a car is estimated at seven years. It is also reported that farmers buy 2.3 tires per year which probably includes some truck tires.

The annual cost of owning and driving a car on a Wisconsin farm is estimated as follows:

First cost of car	$670.00	
Salvage value	40.00	
Net Cost of Car	$630.00	
Annual Net Cost for 7 years		$90.00
Interest 6% of ½ first cost		20.00
Gasoline 357 gal. @ 18c.		64.00
Oil 8 gal. @ $1.00		8.00
Tires 2 @ $9.00		18.00
License		12.00
Insurance, maintenance, repairs, greasing, battery, etc.		40.00
Annual cost		$252.00
Monthly cost		$ 21.00

As a rough check 5131 miles at 5c. is

$256.55. Five cents a mile is a conservative figure when the car is driven only 5000 miles a year. Also, on 22 farms in Barron County, Wisconsin, where careful records were kept, the average personal use of the car was valued at about $127.00. The business use was given about equal value, or $254.00 in all.

At this rate the farmers of Wisconsin spend $44,544,528 a year on automobiles. If the same conditions apply to Indiana, the total figure would be $38,948,112 in that state.

The average farmer spends more than $250.00 per year to operate an automobile. Why does he do it? Because he needs a car and he believes that the value of the service rendered exceeds the cost. For the same reason the farmer will not hesitate to pay the electric bill when he is convinced that he needs it and the value of the service exceeds its cost.

During the ten years preceding the depression, rural electrification moved ahead rather rapidly. In 1920 there were only 130,000 farmers with central station service. By the end of 1932 this number had increased to 709,449, an increase of over 400 per cent. The surprising thing about it is that contrary to almost every other development, the number of electrified farms continued to increase during the depression. By the end of 1933 the total farms served was 713,558 and by the end of May, 1934, the number had increased to 724,367. Today there are more than 200,000 miles of farm line in the United States whose construction cost was in excess of 200 million dollars.

More Rural KWHR Essential

Utility executives whose companies have put up most of this money are not willing, especially in these times, to build more lines and spend more money until the lines now built earn their own way. In most cases these farm lines are not earning their own way because the farmers are not making sufficient use of the available service.

If we can through our cooperative work devise ways and means whereby the farmer can and will make additional profitable use of electric service, then we will remove the greatest obstacle to the rapid development of Rural Electrification. As soon as utility executives see that the farm lines now built are earning their own way they will not hesitate to build additional lines as they are needed.

It seems, therefore, that one of our present problems is to bring about increased use of electric service on existing lines. It is necessary, of course, that this additional service must be profitable to the farmer. I would, therefore, like to offer a few suggestions on how this can be accomplished.

How to Build Bigger Rural Load

There is at the present time a broad gulf between the scientific discovery and the popular acceptance. The discovery of new methods of using electricity on the farm by a committee or the Experiment Station organizations does not help Rural Electrification until the new methods are understood by the farmers along the lines and the farmers have made use of them. The research work and the joint studies must come first, but then it is the job of the utilities, the University and the farm organizations to see that both the utility operators and the farmers who use the service are given full opportunity to take advantage of the new methods. It is, therefore, important that work be given publicity in such a manner that the farmers themselves get to understand the practical application of the results of the tests.

Bulletins from the university which show clearly the practical application are very helpful. The pamphlets and news letters of the National Committee on the Relation of Electricity to Agriculture are reliable and very helpful.

The magazine, *Electricity on the Farm*, devotes all its editorials and advertising space to the farm uses of electricity, and in my opinion can be used as a medium to get the farmer to thinking about new and better methods of using electric service. The regular farm papers have cooperated well in this work and we need their help.

Farmers can't accept and use, they can't even begin to want, anything they don't know about. No matter how old our story may seem to us, there are many of our customers who do not know it. For what we said yesterday is forgotten today, and we have a new audience tomorrow. Some one has said, "We are not addressing a mass meeting,—we are haranguing a parade." Things move so fast we can't tell our story too often.

Continuous Education Necessary

Some years ago the rural service man of the company I am with was taking moving pictures at a farm home chosen because it was unusually attractive and well equipped. There was a modern electric range, electric refrigerator, even an electric clock in the kitchen. They had remodeled the house, had a fine radio and a piano and other musical instruments. But *they pumped by hand and carried in water from a well out in the yard.* And the housewife said, "If some one had only told us about a water system when we were rebuilding!" It is hard to imagine not knowing about a water system, but those folks had the need and the money, but did not know about automatic water supply on the farm.

Another example: Only last week this same man was called to a farm where a flowing well had ceased to flow. The water still came into the basement, but it wouldn't come up into the house. The farmer was not at home, but his wife explained the situation. Then she added, "I told George I wished we could use the motor from a beer pump, but he said I was silly and knew nothing about machinery." He inquired into this beer pump idea and she led him into the woodshed and uncovered a perfectly good Myers shallow well pump with motor, belt, and everything except tank and pressure switch. It seems a tavern keeper had given it to them in payment of some debt, and they had had it right there on the farm all summer without knowing they could use it. We *must* tell our story oftener and to *more* and *more people.*

Advises Special Rural Service

It seems necessary that every utility have at least one rural service man who devotes his entire time to the development of electric service on the farm. Most utilities in the Middle West have invested large amounts of money in farm lines and really cannot afford to let this growing branch of their business take care of itself. Someone in the company must be delegated to look after it if satisfactory results are to be obtained. Such a man should be given sufficient help to keep in touch with the farm customers, and proper backing by the company officials so that his recommendations will be transmitted to those who form the policy of the utility company. Such a man with proper organization and backing can do a great deal in getting the farmers to understand the practical possibilities of every new approved use of electricity in farm operations and can help materially to increase the load.

In every community there are a number of dealers who are in close contact with their farmers. Regardless of the utility company policy toward merchandising, an effort should be made to get the dealers to cooperate in bringing accurate information to the farmers on how electricity can be profitably applied to the farm.

Dealer Cooperation

The company I am with serves 9000 farmers with electric service, and we are now working on the "running

water" campaign. In the same territory, there are some 360 dealers. The dealers as a whole offer a wider variety for selection than we can; as individuals they have been in business longer, and are better known than our individual salesmen; they are in a better position to take in old equipment, gas engines or farm produce than we are; they often carry some supplementary lines that go with electric equipment. With our aggressive help they can do much to help get electricity properly applied to farm operations.

In spreading the knowledge that drinking bowls *increase* butter fat production, that electric ventilation is not only better, but actually *cheaper* than natural draft, that even a small electric water heater *at the barn* practically removes the greatest objection to milking machines, that an inch of water can be pumped on an acre of land for a dollar or two, it should be easier to sell the idea to 360 dealers than to 9000 farmers. The dealers that accept these new ideas won't hold back and talk in favor of old methods even if they are not very aggressive in helping to work on the 9000 farmers. It requires considerable work to get dealers to join such a program, but it can be done—in fact is being done and should produce satisfactory results.

I have talked at some length about load building because it seems to me that it is necessary to build the load so that the present farm lines earn their way before we can expect new money to be forthcoming to build additional lines into new territory.

Happier Farm Life

It is difficult to over-estimate what the extension of electric service into the country means as regards improvement in living conditions and the ultimate influence of this change upon the attitude and psychology of farm people. This can be summed up with the statement that it is no longer necessary to move to town in order to have modern improvements. A farmer can now spend his surplus cash in improving the farm rather than building up a nest egg with which to move to town. If this had been possible 25 or 30 years ago and surplus had been used to build up the country home in place of moving to town and purchasing a building, it is difficult to imagine just where our farming communities would be today in the matter of conveniences. It is my feeling that this change in possibilities will have a material influence in making our farm population more stable and the country a highly desirable place in which to live.

There is going to be no great magic wand which will solve the rural electrification problem. Energy development is rooted in hard work, sensible thinking, and courageous action. It is highly desirable that each group concerned be conscious of their responsibilities.

The present consumption of 600 kilowatt-hours per farm per year now used in the Indiana farms will have to be doubled before the development is on a sound basis. Maximum benefits will accrue to both the farmer and the utility when this consumption is raised to an average of 5000 kilowatt-hours per farm per year. This is over eight times the present average. Not only is this large use possible, but many farmers are today using more than this amount to their own advantage.

We have only started on rural electrification. If all interested groups will continue to cooperate in the future as they have in the past, then there is no question but what our rural areas will in the near future be as completely electrified as urban communities now are.

The Electric Light and Power Business

(Continued from page 2)

have been required to expend $58,000,000 more in their cost of doing business for the year 1934.

In line with the established practice of the industry, rates for domestic service have been lowered from year to year. At the end of 1934, the average price of electricity for household use had dropped to 5.3c per kilowatt hour. Since 1913 the average price of domestic electric service has declined by 39 per cent, although the general cost of living still remains 37 per cent above the 1913 level. If the element of taxes is eliminated, the average price for electricity has been reduced to 4.5c per kwhr, or only little more than one-half the price charged in 1913. The domestic consumer of electricity has steadily been getting more electricity for his money, and his average electric bill of $2.75 per month has remained unchanged for the last four years, although he is getting over 80 kwhr per annum, or 15 per cent more use than in 1930. It is difficult to understand all the agitation and extravagant statements concerning the cost of electric power to the domestic consumer when the total cost is approximately 9c a day—less than the price of a package of cigarettes or of a single good cigar. Seventy-five per cent of all the country's homes use less than the present national average of 52 kwhr per month, and the average lighting consumer, who comprises nearly one-half of all the electricity users of the country, averages only 18 kwhr per month.

The small user of electricity served at a loss is one of the most serious obstacles to the general reduction of electric rates. In Ontario, Canada, and in other areas in the United States and Canada, where for economic reasons and, in some instances, because of subsidies to the domestic consumer, very low domestic rates have prevailed for a number of years, two-thirds of the domestic customers still remain as small users of electricity. In the United States there are 500,000 domestic customers who use 5 kilowatt hours per month or less. Lowering the rates has not materially increased the use of these customers. A large percentage of the customers are necessarily served far below the cost of rendering service.

An outstanding development of 1934 has been the increased activities of the Federal Government in its construction of power projects. The projects already adopted or definitely being considered by the Federal Government will involve for completion of the ultimate plans a total capital investment by the government of approximately three billions of dollars in territory now served by private companies.

The utility companies, like others, are carrying increasingly heavy burdens of taxes, although our burden seems more than that of others. For the country as a whole, taxes now take one dollar out of every seven which the private utility enterprises receive from their customers. In 1934 the total of these taxes came to at least $250,000,000, of which $81,000,000 or one-third went to the Federal Government.

New construction expenditures by the electric light and power industry for 1934 were at the low level of $100,000,000; and it is estimated that for 1935 these expenditures will be approximately the same as for the year just ended. This compares with an average annual expenditure for new construction of $750,000,000 by this industry during the decade from 1920 to 1930.

More Elbow Room

By Wills Maclachlan

AN analysis of accidents to employees of an electrical public utility will show that the accidents resulting in electrical shock or burns, although few in number, are responsible for most of the cost of all of the accidents and most of the suffering of the employees and their families. These accidents are due to working on or near to energized lines or apparatus.

A study of the injuries from these accidents shows that the point of contact between the man and apparatus is the elbow, shoulder, back of neck, back of head, knee or foot.

As a usual thing, the problem is lack of elbow room. When working on live lines or apparatus the employee is suitably protected to below the elbows, with tested rubber gloves and leather covers, and the real hazard is not from contact between his hands and energized apparatus. When working on dead wires or apparatus, near live apparatus, he is frequently working bare-handed, and these bare hands are a source of danger. In either case, if he watches each movement and is always on the alert, the hazard of the work is minimized. We are dealing, however, with human beings and not mechanical Robots. It is not possible for him to continuously carry out these mental processes and to always watch each movement.

When working on dead apparatus near live equipment, as much of the surrounding live equipment as is possible should be isolated and grounded. Where this is not possible, substantial insulating or preferably grounded guards should be installed to protect the employee from contact with live apparatus when he makes inadvertent movements.

When working on live apparatus, the adjacent live or grounded apparatus should be guarded by suitable insulating guards.

To make these precautions possible and effective requires in existing plants and lines careful study by executives and the development of suitable and practical rules for the individual situation. The necessity for then training the staff in the rules and enforcing the rules is assumed.

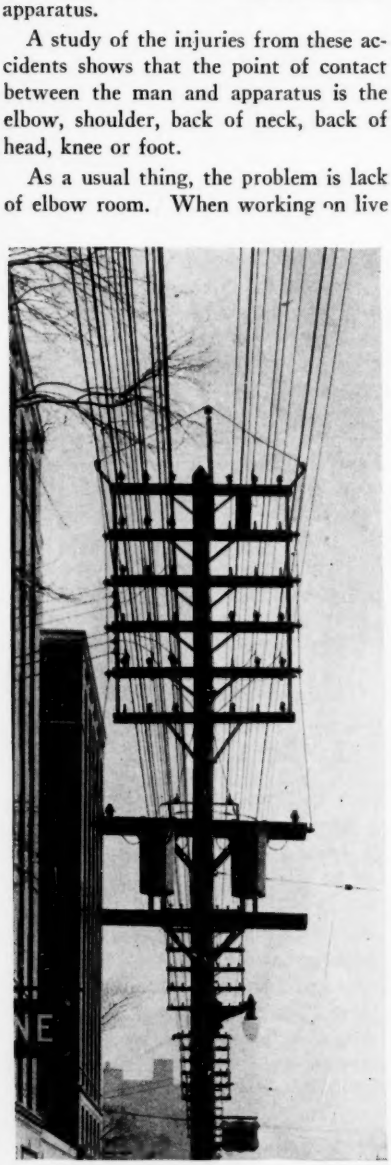
In new plants and lines the designing engineer, by study and knowledge of the problem, can arrange that it is possible to carry out this work safely and with ample room.

Probably the two points that militate against the use of provided protection and rules in the field and have caused most accidents are:

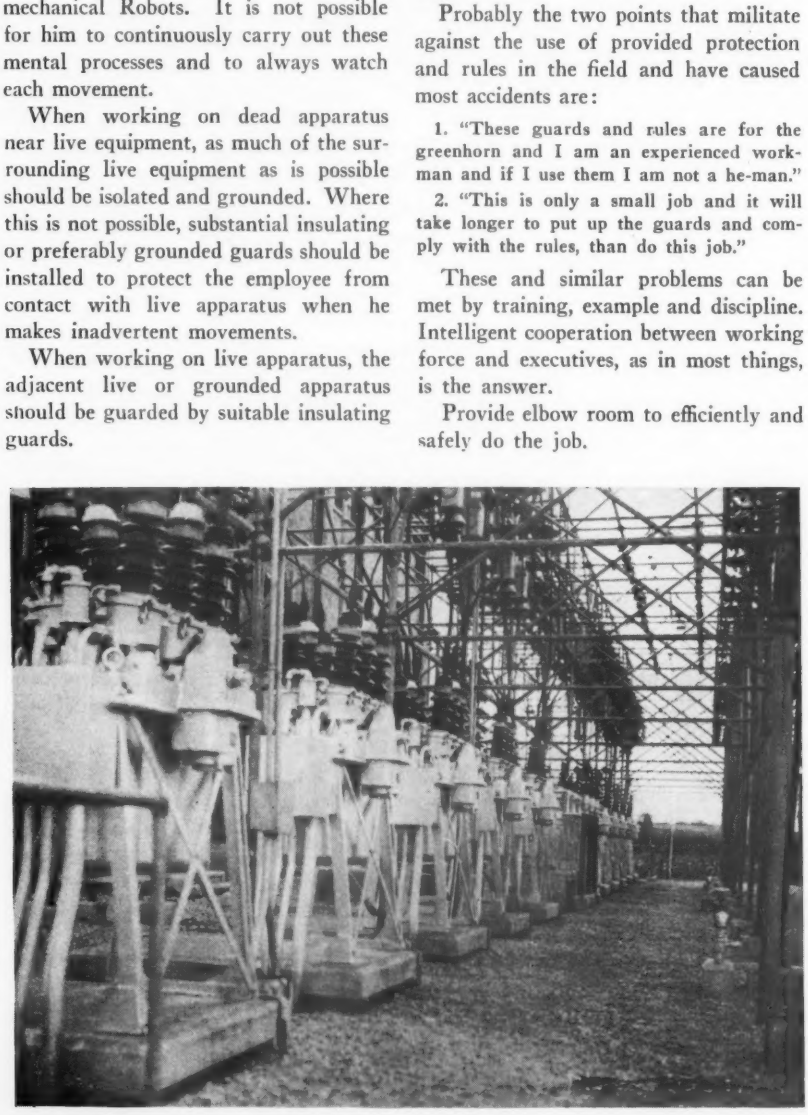
1. "These guards and rules are for the greenhorn and I am an experienced workman and if I use them I am not a he-man."
2. "This is only a small job and it will take longer to put up the guards and comply with the rules, than do this job."

These and similar problems can be met by training, example and discipline. Intelligent cooperation between working force and executives, as in most things, is the answer.

Provide elbow room to efficiently and safely do the job.



Type of overhead construction with clear climbing space and easily identified and protected circuits



A clear-cut outdoor switch yard with ample room for safe maintenance

Hurdles for 1935

By C. E. Greenwood

Commercial Director, Edison Electric Institute

AGAIN we arrive at the first month of the new year, the time when inventory of past commercial accomplishments is studied and made the basis of new objectives before the records are placed in the archives.

For the first time there has been a Federal "yardstick" to study also. The load-building ledger records the government experiment in the TVA, which aims to bring to the masses low-priced electricity and complete electric service in the home. Political rumor would have us believe that this venture is one of a series of sample tests.

MR. GREENWOOD

The zeal of the commercial executive of the private utility is somewhat dampened when he views the method of his competitors in hurdling the obstacles which he has faced for so many years in his load-building problems. "Hellesbells!" he says, "I couldn't get away with that." He realizes that the station load factor of his company may be under 50 per cent, and that means capital investment is employed less than half time. He is searching for a means to increase that investment efficiency.

It requires no stretch of his imagination to realize that domestic service is the class that must work more hours per day to bring in the much-needed revenue. He must do it if his company is to pay higher prices for labor and material, and meet an ever-increasing tax burden, and have anything left for those who have furnished the capital for the business. His executives want to be fair to consumer and investor.

The services that help most in load building are refrigeration, cooking and water heating. The oil furnace, balanced by consumer room cooling, will also help materially. It is the long hour "automatic" electric services that roll up the kilowatt-hours in volume sufficient to make possible lower average rates. The motor-driven labor-saving appliances for washing and cleaning, together with a well-sold group of table cookery devices, are paid for in the first and second steps of the rate schedule, and will make a substantial contribution to revenue. Properly sold, they may add another 100 kilowatt-hours to our present national average of approximately 630 kilowatt-hours. But there is no magic wand that can be waved over the household to increase electric consumption to national averages of 1200 to 1500. To attain that goal electric cooking and water heating must be vigorously pushed. A saturation of 15 to 20 per cent of these services would "earn" yardstick rates for the utility.

The government can, in connection with its experimental activity, make arbitrary, uneconomic adjustment of rates, and then attempt to justify them on the basis of encouragement of use. Without question lowered rates bring in increased energy use, but low rates in themselves do not bring universal liberal use. This is indicated from an analysis of customer use in Tacoma, Wash., in 1932, as presented in a paper by Mr. J. D. Ross, Superintendent of the Lighting Department of the City of Seattle. The average rate in Tacoma for residential customers was approximately 1.73 cents for 1550 kilowatt-hours. However, approximately 15 per cent of the residential customers paid 4½ cents per kilowatt-hour for a use of 20 kilowatts or less. Of the total of 27,056 customers in the breakdown for 1932, the average use of energy by 72 per cent of the total was 50 kilowatt-hours per month, which is about the average of all domestic consumers for the entire United States. The large average use in Tacoma is the result of the electric range, water heating and house heater services, which are confined to about one-quarter of the total number of customers.

The commercial executive has first a rate situation which must be solved if not now in the clear. The "Objective" rate is the call of the hour. During 1934 there have been tests by utility companies on the use of electricity if it were *free*. Applications of this principle are expected to spread during the coming year.

The manufacturers have complied and cooperated with government agencies to produce quality appliances at prices much more nearly in reach of the masses than in years previously. Starting with a line of models for the people who are to be served through the Electric Home and Farm Authority, they have extended the market, and many manufacturers now offer for national distribution low-priced special models formerly restricted to a sectional area. The goal of quality products of leading manufacturers, at prices to meet the purchasing power of lower-bracket incomes, has been the subject of many a conference between manufacturer and utility groups over a term of years. New lines have arrived at an opportune time to aid the commercial executive in handling this second obstacle.

And what about terms of purchase? Finance problems have always been tough ones to solve, especially for the smaller dealer. The utility that merchandises appliances has limited its terms for the past few years in deference to

the wishes of competitive outlets. But we are living in an age of almost kaleidoscopic changes. In 1931 and 1932 there was a wave of anti-utility merchandising state legislation backed by dealers who, among other grievances, held that the private utility was unfairly competitive in terms, extending them for two years and in certain instances even more.

What changes have come about in the interim! The EHFA says three years for a range, refrigerator, and water heater purchased singly and four years for the purchase of any two at one time, is sound practice, and will be followed in TVA districts. The Federal Housing Administration has included the electric range, water heater and refrigerator in the list of household equipment subject to insured loans, and three years is allowed for payment on bank loans by the home owner.

The commercial executive must take this last hurdle of long-term payments on the range and water heater. If discount agencies are making such terms under government insurance of 20 per cent of the losses, the utility is not only justified but has an obligation to make it easier for the consumers it supplies to obtain these major services. There is a minimum of interference with the dealers on these two items, and local compensating adjustment can be made.

The straight Rental or Rental-Purchase Plan, common practice in England in recent years in range and water heater promotion, is gaining in favor among utility men in this country. One city, with 57,000 residence meters, where ranges had been sold for twenty years, attained a density of 5½ per cent up until the time the Rental Plan was put into effect. In less than two years after the rental plan was installed, density was raised to 10 per cent.

The electric utility has to take large strides in 1935. Leading companies are marching forward commercially with well-defined and comprehensive programs for load development. There are some problems common to all, but the complexion of the local market will govern local approach to solution. Which reminds the writer of editorial comment in a recent issue of a leading trade journal, concerning the variation in utility practices in selling. Oddly enough one of our leading commercial executives voiced similar comment after a review of the variable merchandising practices of forty-five central station companies when he said, "They can't all be right."

However, a careful analysis is convincing that the economics of the situation are not always the sole determining factor. Commercial practices are sometimes advisable not because the executive thinks they are sound, but political expediency may be a governing motive. This is true today in many lines of business, and constitutes still another handicap which has been added to executive burdens.

Let the vigorous selling and promotion of electrical services proceed with unabated enthusiasm.

Let us enjoy a large measure of satisfaction in the knowledge that the marketing of kilowatt-hours is a man's game. It takes skill, courage and perseverance. There are new thrills mingled with disappointments. But the industry is going forward and great commercial gains will be the strongest weapon for defeating formidable opponents. Whoever plays his full part will find inspiration and reward.

CORRESPONDENCE

To the Editor:

RECENTLY I took part in an engineering investigation made for the purpose of aiding and promoting the wider use of electricity. This investigation was carried out in the territories served by 14 separate utility companies located in 12 different states east of the Mississippi. It required a visit to the premises of the customers, thorough inspection on each of the properties and detailed tests in a number of cases. About 50 commercial and industrial establishments of varying size and character were visited, and about 100 homes ranging from a minimum class of residence development to some of the finest urban and suburban homes. These locations were picked so as to obtain representative technical conditions on the premises, and with little thought given to the opinion held by the customer of the utility.

The procedure followed was to first explain in detail the methods for carrying out the investigation to an official of the utility in the territory, and then proceed to the individual inspections with a junior employee of the utility company to make the initial contact and obtain permission from the customer. In several of the territories the utility official, although approving of the methods, was doubtful of the reception which might be received at the hands of the customer. The investigation, of course, involved some inconvenience and annoyance to the customer, and it was pointed out that the customers, perhaps, were not in a mood to be even slightly inconvenienced to assist the activities of the utility. The investigators were cautioned that they should not be surprised to have some of the customers refuse permission to enter and inspect their premises.

The customers, on the other hand, after a very brief introduction as to who the investigators were, and the purpose of the investigation, gave permission in every case to carry through the desired inspection and tests. In a few cases an inquiry was made whether our investigation would increase the monthly bill. When assured that the investigation would not increase the bill, and was aimed only at a wider and greater use of electricity, any reluctance on the part of the customer was removed. It was found that a rainy Monday was a bad day for making inspections on residential premises, but only because the housewife was very apologetic regarding clothes hanging in the basement. On several occasions more discussion was required to prevent the housewife from taking down the clothes in the basement so as not to inconvenience us than was ever required to obtain permission for the investigation. In a number of cases the reception was cordial and the members of the household, or the head of the industry, made somewhat of a social occasion of our visit, and carried on a general conversation during the whole time of the inspection and test.

Although 150 customers is a small sample of the several million in the territory visited, it is reasonable to believe that the uniformly friendly opinion of these people toward the utility is a better pointer of the direction of public opinion than the politician or the soapbox orator from whom so much has been heard in recent months.

J. O'R. Coleman.

New York, Jan. 10, 1935.

Electrical Equipment Committee Meets in February

A meeting of the Electrical Equipment Committee will be held in Cincinnati at The Netherland Plaza Hotel on Monday and Tuesday, Feb. 18 and 19.

McGraw Prize Paper

Hydro Station Operation With Minimum Loss

By S. O. Schamberger

DURING the past ten years more and more attention has been given to producing the maximum number of kilowatt hours from every cubic foot of water Nature has made available at our hydro stations. The machinery manufacturers have been given the incentive to spend time and money in research which has resulted in an improvement in operating efficiencies and a reduction in machine outage time. Field measuring sticks, with laboratory accuracy, have been devised whereby it is possible to know the operating characteristics of each and every unit of the line under all conditions. Having been given all this, what is the operator doing to make proper and judicious use of his tools, and what means has he taken to satisfy himself that his mode of operation is productive of the maximum return on the money expended?

Starting in 1924 one of the constituent companies of what is now the New York Power and Light Corporation placed in operation a "Daily Hydro Summary," which attempted to determine the losses in hydro station operation due to carrying inefficient loads on the units and due to improper loading of the various connected stations resulting in uneconomical draft from pondage and the attendant loss of head and power output. It very soon became apparent that if much confidence was to be placed in the results being obtained from these daily calculations that their basis, or the unit characteristics, must be known with a high degree of accuracy. "Gibson" or "Allen" tests were made on all the major units of the system and the operating characteristics were determined for all conditions of operation. This information was given to both the system operators and the station operators as a tool to help in the efficient performance of their daily tasks.

With better tools the "Hydro Summary" grew and is now used in all the larger plants of the system and is known as the "Hydraulic Log." It indicates not only the character of the losses occurring but also the true amount of the losses accruing due to improper distribution of load between the units in the station, to uneconomic total load carried by the station as a whole, to excessive leakage through the gates of the water wheels, to the failure to "start the day right" with the pond full or maximum head on the plant, and to the motoring of the units for voltage correction or relay purposes. In addition to this, the hydraulic log indicates the useful kilowatt hours per year possible from the available water which might be delivered as surplus or to increased firm load, and the excess kilowatt hours available from water in excess of the existing station capacity.

The fundamental rules of operation for minimum loss at a station are fourfold, and the extent to which these rules are adhered to determine the overall efficiency of operation. These rules may be briefly stated as:—

1. Enter the peak load period with the pond at operating crest. (As with all rules this one has many variations and exceptions due to time lag of stream flow between plants on the same stream, varying characteristics of demand of plants on the same stream, etc., etc.)
2. Assign a load which with the stream flow available may be carried at a minimum of loss for the station.
3. Distribute the assigned station load for maximum overall efficiency.
4. Never operate a unit at speed on no load condition. If it is required for relay or other purpose without efficient generation, it should be motored with energy received from the system and with the draft tube vented and the water wheel runner out of the water.

In the New York Power and Light Corporation system the responsibility for operation in accord with rules 1 and 2 is placed upon the System Operators and the responsibility for operation in accord with rules 3 and 4 is placed upon the Station Operators. The System Operator assigns the load to be carried by every station and the Station Operator distributes that load most economically between the units in the station.

Based upon the tested characteristics of the units in the station, the System Operator has prepared for his use a chart such as shown in Fig. 1, giving the losses incurred in kilowatts for any station loading at any head which may be available. This curve in turn is based on the most economical division of that load between the units in the station, and having assigned an economical station load the System Operator's responsibility ends and the Station Operator's responsibility begins.

Again based upon the tested characteristics of the units in the station the Station Operator has prepared for his use a table (tables having been found preferable to charts by the men actually engaged in station operation) such as shown in Table 1 giving for any station load the individual unit loads which should be carried. These tables are based upon the principles of economic loading which have many times in the past ten years been described in the technical press, notably in the paper presented by Rogers & Moody at the Third American Hydraulic Conference at the Engineers'

MR. SCHAMBERGER

Mr. Schamberger is the winner of the 1934 third McGraw Award. He is a native of Gloversville, N. Y., where he was born in 1897. He was educated in the public and high schools of Gloversville, graduating from Union College, Schenectady, in 1919 with a degree of B.S. in E.E. Mr. Schamberger has been associated with the New York Power and Light Corporation since 1922, when he was assistant to the Hydraulic Engineer. In 1928 he was appointed Hydraulic Engineer, the position he now holds

TABLE I—Division of Load Between Units for Best Efficiency

(For 94 ft. Gross Head)

Total Load on Station	Loading No. 3	No. 4	No. 5	Total Load on Station	Loading No. 3	No. 4	No. 5
0	Motor	Motor	Motor				
1,000	Motor	1,000	Motor	15,500	5,200	4,000	6,300
2,000	Motor	2,000	Motor	16,000	5,200	4,500	6,300
3,000	Motor	3,000	Motor	16,500	5,200	5,000	6,300
4,000	Motor	4,000	Motor	17,000	5,200	5,000	6,800
5,000	Motor	5,000	Motor	17,500	5,200	5,000	7,300
6,000	Motor	6,000	Motor	18,000	5,200	5,000	7,800
6,200	3,900	2,300	Motor	18,500	5,200	5,000	8,300
6,400	4,000	2,400	Motor	19,000	5,300	5,000	8,700
6,600	4,100	2,500	Motor	19,500	5,400	5,100	9,000
6,800	4,200	2,600	Motor	20,000	5,500	5,300	9,200
7,000	4,300	2,700	Motor	20,500	5,700	5,400	9,400
8,000	4,700	3,300	Motor	21,000	5,800	5,500	9,700
9,000	5,200	3,800	Motor	21,500	5,900	5,600	10,000
10,000	5,200	4,800	Motor	22,000	6,000	5,800	10,200
11,000	5,700	5,300	Motor	22,500	6,100	5,900	10,500
11,500	Motor	5,000	6,500	23,000	6,200	6,100	10,700
12,000	Motor	5,000	7,000	23,200	6,300	6,100	10,800
13,000	Motor	5,000	8,000	23,400	6,300	6,200	10,900
14,000	Motor	5,100	8,900	23,600	6,400	6,200	11,000
15,000	Motor	5,400	9,600	23,800	6,400	6,200	11,200

TABLE II—Discharge of Unit No. 3 In C.F.S. for Various Gross Heads

(Data from Test Results of April 10, 1931)

Kw. Load	GROSS HEAD 86′	87′	88′	89′	90′	91′	92′	93′	94′	95′	96′	97′	98′
0	174	172	170	168	166	164	162	160	159	158	156	154	152
500	215	215	216	216	216	217	217	217	218	218	218	219	219
1,000	280	280	279	279	278	278	277	277	277	276	276	275	275
1,500	345	343	342	341	340	339	338	336	335	334	333	332	331
2,000	410	407	405	403	401	399	397	395	394	392	391	389	388
2,200	436	433	430	427	425	423	422	420	418	416	414	412	410
2,400	461	458	455	452	449	447	445	443	442	440	438	436	434
2,600	486	483	480	477	474	471	469	466	464	462	460	457	455
2,800	512	508	505	502	499	496	493	490	488	485	483	480	478
3,000	537	533	530	527	523	520	517	514	511	508	506	503	500
3,200	563	559	555	551	548	544	541	538	535	532	529	525	522
2,400	588	584	580	576	572	568	565	561	558	555	552	548	545
3,600	614	610	606	601	597	593	589	585	582	578	575	571	567
3,800	641	636	632	627	622	617	613	609	605	601	598	594	590
4,000	667	662	657	652	647	642	638	633	629	625	621	617	613
4,200	693	688	683	678	673	668	663	658	654	649	645	640	635
4,400	719	714	708	701	695	691	687	682	677	672	668	663	658
4,600	747	741	734	727	721	716	711	706	701	696	691	686	681
4,800	779	771	762	755	747	740	735	730	725	720	715	709	704
5,000	813	803	793	784	775	767	760	753	748	742	737	731	726
5,200	855	841	828	817	807	797	788	781	774	767	760	754	749
5,400	902	884	868	855	842	830	819	810	802	795	786	779	772
5,600	963	937	915	897	881	867	853	842	833	824	814	806	798
5,800	1,037	1,005	975	950	928	909	892	878	867	855	845	835	825
6,000	...	...	1,049	1,017	987	961	939	921	905	890	878	866	855
6,100	...	...	...	1,054	1,022	993	966	945	926	911	897	884	872
6,200	...	...	...	...	1,058	1,027	997	972	950	932	917	902	890
6,300	...	...	...	...	...	1,063	1,031	1,003	977	955	937	921	908
6,400	...	...	...	...	...	...	1,068	1,037	1,007	982	960	943	927
6,500	...	...	...	...	...	...	...	1,071	1,040	1,012	987	965	947
6,600	...	...	...	...	...	...	...	...	1,075	1,044	1,017	991	970
6,700	...	...	...	...	...	...	...	...	...	1,079	1,049	1,020	997
6,800	...	...	...	...	...	...	...	...	...	...	1,082	1,052	1,025
6,900	...	...	...	...	...	...	...	...	...	...	...	1,086	1,056

Club of Philadelphia in May, 1925, on "Inter-Relation of Operation and Design of Hydraulic Turbines," and in an article by E. B. Strowger in the *N. E. L. A. Bulletin* of December, 1929, on "Operating a Hydraulic System for Best Economy and Means Employed for Checking Performance of Operation."

Preparation having been made for the economic assignment of the load and the economic distribution of the load, the Hydraulic Log comes along and shows just how well or how poorly the job is done. It is prepared entirely by the Station Operator as a part of his routine work and, although it adds to his labors, it has also made available to him more vital information concerning the machines he operates and has increased his interest in his job and his desire to do a better job if possible. This does not mean that prior to the use of the Hydraulic Log the operator was "lying down," but that with his new tool he can do more and better work and KNOWS it.

On the Hydraulic Log as shown in Fig. 2 hourly readings of pond and tailrace levels, sluice gate discharge, etc., are taken and recorded. At every CHANGE IN STATION LOAD a reading of the generator watthour meters is taken and recorded and then the calculation is made to determine the efficiency of operation or the amount and distribution of the losses which have occurred. In these calculations two fundamental rules are used as a basis:

1. The losses in pipe line friction, the water wheel and generator occurring at maximum possible station efficiency, cannot be regained, and therefore at maximum overall efficiency the station has an OPERATING EFFICIENCY of 100 per cent.
2. Except when the average daily stream flow is in excess of the most economical station load the station should be loaded preferably at this point of maximum efficiency to result in a minimum of loss.

From the hourly observations to obtain the gross head on the station and the periodic observations to obtain the unit load the following calculations are made as indicated in the Appendix, which is a sample of the instructions issued to the Station Operators. The total generation by each unit divided by the elapsed time of the period of uniform operation will give the average unit load which when referred to the "Unit Discharge" table such as shown in Table II will give for the particular operating head the rate of discharge through the water wheel. The total of all the unit discharges gives the station discharge which is not only used for the determination of the operating losses but also for

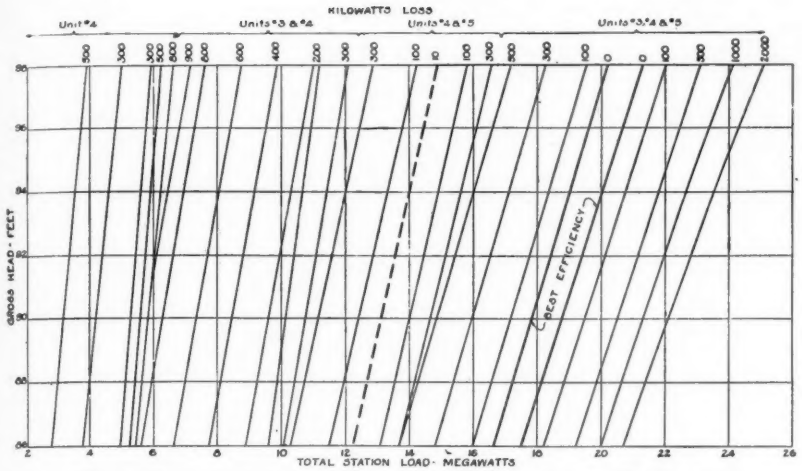


Fig. 1—Losses when station is not operated at most efficient load

the record of stream flow which is maintained at all important stations.

From the calculated station discharge and the gross head and by means of an Economic Loading curve such as shown in Fig. 3, the maximum load possible under these conditions is determined. This loading curve assumes that the load division between units is made in the most economical manner as previously set up, so that the difference between this possible generation and the actual generation as determined by the watthour meters is the loss which has been the result of improper division of load between the units in the station.

Knowing the maximum operating efficiency for the station from the actual field tests, it is possible to set up the kilowatt hours which might have been generated during the same period of uniform operation with the same station discharge and the same operating head.

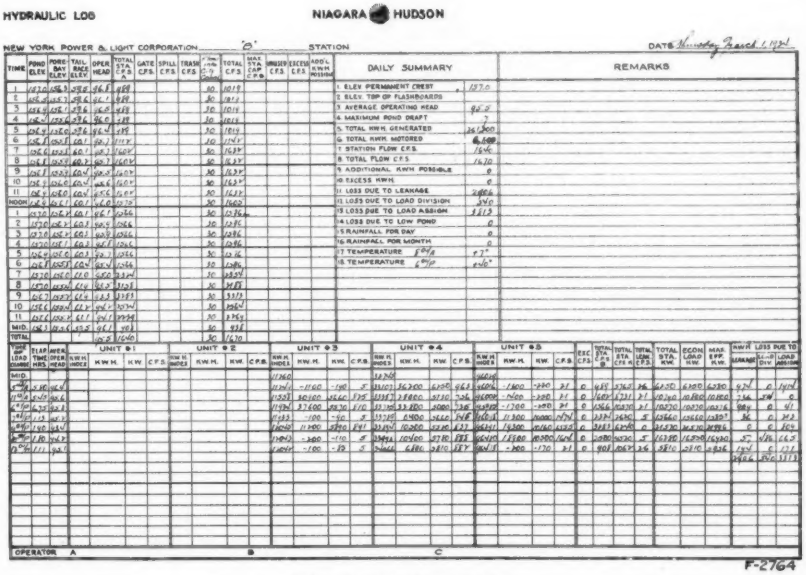


Fig. 2—Hydraulic log

To do this the Station Operator has given to him a single factor determined from test by which he multiplies the head and discharge to obtain the so-called "Kilowatts at Maximum Efficiency." It is apparent then that the difference between this figure and the most economical load obtainable with that definite discharge and head is the loss which has resulted from improper load assignment.

In addition to the losses due to load division and load assignment, calculations are also made to determine the losses accruing due to the leakage through the water wheel gates during periods of shut down. Such loss cannot be charged against operation, as it is definitely a loss due to improper or delayed maintenance,

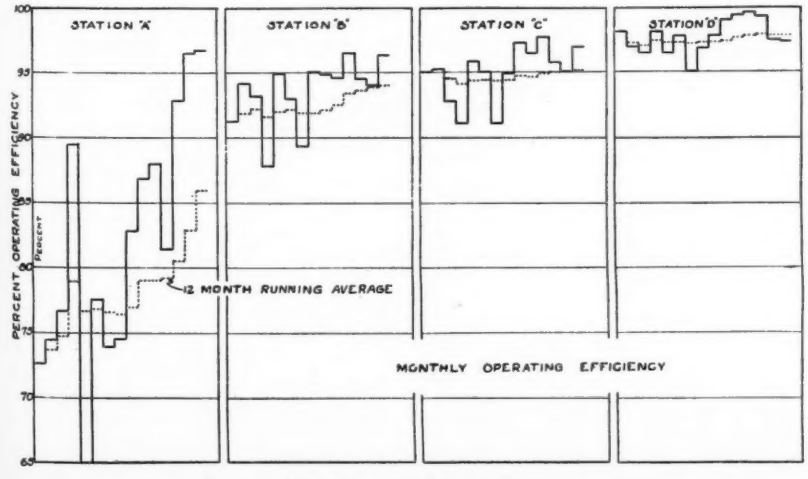


Fig. 4—Monthly operating efficiency chart

and furnishes a basis for a decision as to the time to take the necessary steps for overhauling of the equipment. These leakage losses are periodically checked in the field, and if necessary corrections are made in the instructions to the Station Operators.

Losses due to unwarranted draft on the pond resulting in entering the peak period below crest, are calculated at the end of the day simply by the ratio of the total actual generation to the actual head and the head loss due to the low pond. At stations where week-end pondage is a vital factor in the operation, this loss due to low pond cannot be considered a total loss, but only a measuring stick for comparison with results obtained in two or more similar periods of a week or a month.

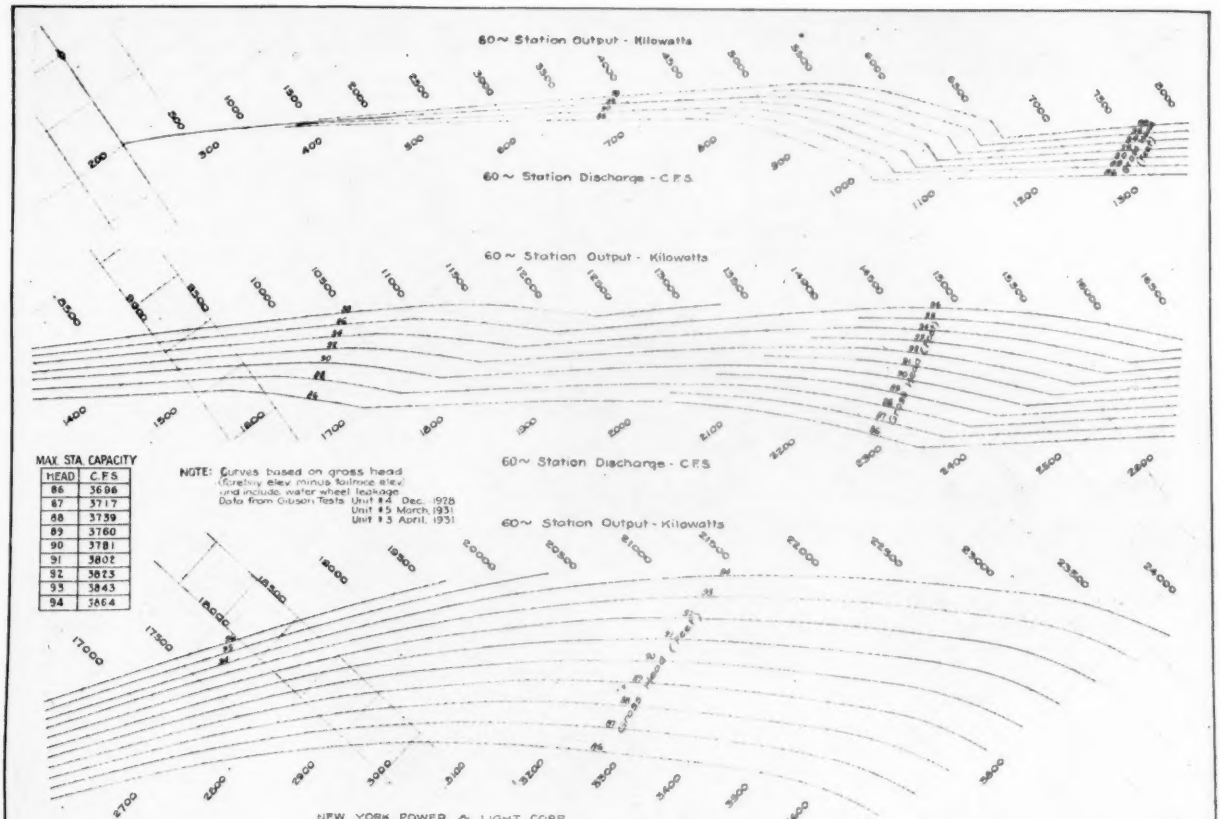

60~ Station Output - Kilowatts
60~ Station Discharge - C.F.S.
60~ Station Output - Kilowatts
60~ Station Discharge - C.F.S.
60~ Station Output - Kilowatts
MAX. STA. CAPACITY
HEAD C.F.S.
86 3696
87 3717
88 3739
89 3760
90 3781
91 3802
92 3823
93 3843
94 3864
NOTE: Curves based on gross head (forebay elev. minus tailrace elev.) and include water wheel leakage
Data from Gibson Tests Unit #4 Dec. 1928
Unit #5 March, 1931
Unit #3 April, 1931
NEW YORK POWER & LIGHT CORP.
SCHOOL ST. HYDRO STATION
TOTAL DISCHARGE WITH ECONOMIC LOADING
FOR 60~ STATION UNITS 3, 4, 5
60~ Station Discharge C.F.S.

Fig. 3—Economic loading curve

With such an operating schedule set up and a scheme for recording the operation devised the question may be asked, "What is done with the information and what value has it?" These questions are proper for both the Management and every man down the line, especially the Station Operator whose job it is to do the actual work.

The daily summary of the Hydraulic Log calculations are brought together in a monthly summary for study by the Operating Department and for report to the Management. To the daily kilowatt hour losses are assigned their replacement value in the system which puts them into terms of dollars and cents having a real meaning to everyone. In this way the Operating Efficiency of the station is given a value which can be appraised by Operator and Manager alike, the one visualizing the fruits of his careful daily work and the other maximum good derived from the use of the "talents" assigned to his guardianship. An example of this appraisal by the Operator may be seen in Fig. 5, which shows the result of the increased interest of one

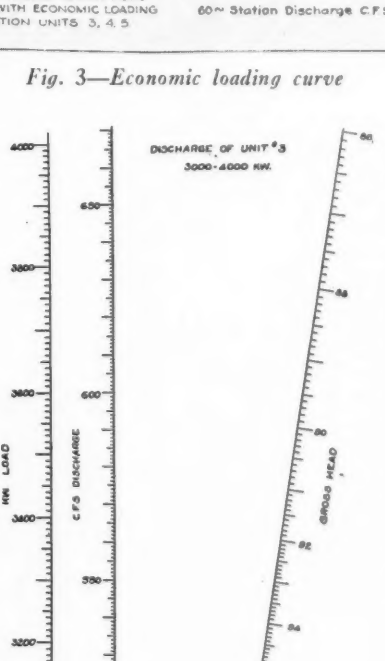


Fig. 5—Monographic chart converted from Table II

man who while operating on a shift converted Table II into a monographic chart for his own and his colleague's use.

In addition to the general checking of station operation this monthly summary focuses attention upon sudden and marked changes in losses, and these are subject to investigation which may be responsible for the correction of operating practises which would otherwise continue over a long period and result in a considerable loss of revenue. The curves shown in Fig. 4 indicate clearly the danger signals which are set and the general improvement which may be and which has been accomplished in several stations. And so in this manner the Hydraulic Log becomes another tool with which our hydro facilities may be put to their greatest use and result in the maximum return on the invested capital in our Utility System. Like any other tool it has little value if placed on the shelf. It must be used and when used as described it can be and is being of great assistance in the improvement of our operations.

APPENDIX

HYDRAULIC LOG—INSTRUCTIONS—FIG. 2

General

The hydraulic log is divided into three parts. The first, shown at the bottom of the sheet, is for the computation of flow through the plant and the computation of losses due to leakage, load division, and load assignment. The computations made in this part of the log sheet are based on periods of constant station load and hence may vary in length from less than an hour to several hours. The second part contains regular hourly readings and is used for the computation of flows which are wasted. Hourly station flows are also computed from results obtained in the first part. The third part is a summary of results obtained in the other two parts with additional data on rainfall, temperature, and dam crest.

Time of Load Change

The actual time at which any load change is made.

Elapsed Time

The difference in time in hours (changing minutes to decimals of an hour) between two consecutive readings in the preceding column being the time over which the station load was constant.

Average Operating Head

This is the average operating head effective over the period "elapsed time."

Unit Kwhr Index

The reading of the watthour index at the time of load change.

Unit Kwhr

The difference betweeen two consecutive readings of the watthour meter index.

Unit Kw .

The unit kwhr divided by the elapsed time. This gives the average kilowatt load on the unit during the period and should be computed to the nearest ten kw.

Unit CFS

Using unit kw and average operating head, compute the cfs from the discharge table.

(NOTE: If one or both units are motoring or idle with butterfly valves open, the leakage quantity should be noted under cfs.)

Total Station CFS B

Total of the unit cfs.

Total Station CFS H

Total station cfs B multiplied by elapsed time.

Total Leakage CFS

Total of leakage quantity entered in total station cfs B.

Total Station Kw

Total of unit kw.

Economic Load Kw

The kw taken from the curve of economic load division using total station cfs and average operating head.

Kw at Maximum Efficiency

Total station cfs multiplied by operating head multiplied by factor A.

With one unit running A = 0.0690
With two units running A = 0.0705
With three units running A = 0.0717

Kwhr Losses Due To:

Leakage

Elapsed time multiplied by the total leakage cfs multiplied by average operating head multiplied by the factor 0.067.

Load Division

Elapsed time multiplied by the difference, economic load kw minus total station kw.

Load Assignment

Elapsed time multiplied by the difference, kw at maximum efficiency minus economic load kw.

Pond Elevation

Hourly pond elevation on U.S.G.S. datum.

Forebay Elevation

Hourly forebay elevation on U.S.G.S. datum.

Tailrace Elevation

Hourly tailrace elevation on U.S.G.S. datum.

Operating Head

Pond elevation minus tailrace elevation.

Total Station CFS A

The average discharge through the units for the hour. It is computed from the column "Total Station CFS B." If there is no load change during the hour it is the same as B. If there is a load change, it is the weighted average of the various discharges of B during the hour.

Gate CFS

Hourly discharge through taintor gate from table.

Spillway CFS

Hourly discharge over spillway or flashboards from table.

Log, Ice and Trash Chute CFS

Hourly discharge through ice chute from tables.

Total CFS

Hourly total of total station, gate, and spillway cfs.

Maximum Station Capacity CFS

The maximum station capacity in cfs for the operating head for the hour from the table.

Unused CFS

When "total cfs" is greater than "maximum station capacity," "unused cfs" is equal to "maximum station capacity" minus "total station cfs A."

When "total cfs" is less than "maximum station capacity," "unused cfs" is equal to "total cfs" minus "total station cfs A."

Excess CFS

Total cfs minus maximum station capacity.

Additional Kwhr Possible

When "total cfs" is greater than "maximum station capacity" in cfs, "additional kwhr possible" equals "maximum station capacity" in kw minus kwhr generated.

When "total cfs" is less than "maximum station capacity" in cfs, to obtain "additional kwhr possible" subtract kwhr generated from kwhr obtained from economic loading chart using "total cfs" and operating head.

Obtain kwhr generated for the hour from electric log.

SUMMARY—HYDRAULIC LOG—INSTRUCTIONS

1. *Elevation of Permanent Crest—157.0*
2. *Elevation Top of Boards*
   Actual elevation of flashboard crest.
3. *Average Operating Head*
   Average of hourly operating heads during hours when station was *generating.*
4. *Maximum Pond Draft*
   This is the maximum amount the pond is drawn down during any number of successive hours of the day. In case water is spilling part of the day and then drawn below spilling crest, the pond draft is the difference between the spillway crest elevation and the lowest pond elevation which follows. When the water is spilling all day or the pond gains all day, the pond draft is zero.
5. *Total kwhr generated* } Copied from
6. *Total kwhr motored* } electric log.
7. *Station Flow CFS*
   Total of column station flow CFS H divided by 24 which should equal the total of column "Total Station CFS A" divided by 24.
8. *Total Flow CFS*
   The total of column "Total Flow" divided by 24.
9. *Additional Kwhrs Possible*
   Total of column "Additional Kwhr Possible."
10. *Excess Kwhr.*
    Total of column excess cfs multiplied by average operating head multiplied by factor .067.

    Kwhr Losses Due To:
11. *Leakage*
12. *Load Division*
13. *Load Assignment*

    Total of losses indicated

When total flow for the day is greater than 3700 cfs, loss due to load assignment is zero.

14. *Low Pond*
    Elevation top of flashboards minus maximum pond elevation for the day multiplied by total generated for the day, divided by average operating head for the day.

    There is no loss if water is wasted.

    Value of Kwhr Losses

    The value of these kwhr losses to be determined from rates established by the system operator throughout the day and to be recorded under "Remarks."
15. *Rainfall for Day* } To be copied from
16. *Rainfall for Month* } electric log.
17. *Temperature* } Copied from electric log.
18. *Temperature* }

Under Remarks the following should be noted in particular:

Any change in or abnormal condition of flashboards.

In case of spilling over boards, the estimated condition of the boards, and after water has dropped the actual condition.

The time of opening and closing of butterfly valves.

The time of opening and closing of taintor gate and amount of opening.

A First of the Year View of National Better Light-Better Sight Activities

A Remarkable Showing

SOME idea of the magnitude of the Better Light-Better Sight program, nationally, may be gained from the following information collected from reliable sources:

It is conservatively estimated that in 90 per cent of the cities of the country with a population of 10,000 or more, some kind of a Better Light-Better Sight activity has been carried on during 1934.

Fully 85 of the privately owned electric utilities of the country have directly conducted, or were indirectly promoting, an eyesight conservation program through Better Light for Better Sight. A substantial number of municipal lighting companies have encouraged and developed campaigns locally for Better Light-Better Sight.

More than 5000 persons on utility staffs are now devoting their full time to selling better "seeing" in homes, stores and factories. Over 2500 of these have been added since last July, indicating a prompt recognition of new business possibilities and the quick response and receptiveness of the public to the value of better seeing conditions.

In the combined electrical, paint and optical industries it is estimated that over 250,000 persons are active or indirectly doing their bit in promoting eyesight conservation and Better Light for Better Sight.

More than 35 Better Sight Bureaus have been organized in important cities throughout the country and the number is growing rapidly.

Meetings and educational gatherings held within participating organizations during the year total more than 5000 with a total attendance estimated at 350,000.

One large electrical manufacturer alone conducted a series of Better Sight schools last fall in important centers blanketing the country, which were attended by 25,000 persons and at which 8500 enrolled students received instructions on how to sell better seeing to the public.

Manufacture of I. E. S. certified portable lamps started last July. As of December 31 over 315,000 of these new lamps, scientifically designed to give adequate lighting for reading and studying, were sold. At present rate of sales it is predicted that 1,000,000 will be sold and in use by the end of 1935.

Since there are 7,000,000 wired homes in the country with children of school age, such an accomplishment of approximately 14 per cent saturation in a little over a year after introduction is noteworthy evidence that the public is interested in better seeing conditions.

The supervisory agency of the portable lamp code authority reports that in November the portable lamp industry was operating on a basis close to the peak year of 1929. Employment, which had dropped to 31 per cent in 1932, had in November recovered to within a very few per cent of the 1929 status and the volume of business was showing a like improvement.

Some of the manufacturers credit the new certified portable lamps very largely for this sudden recovery—several stating that the bulk of their present business is production of these lamps.

More than 20,000 of the small light measuring meters are reported in use at present and they are now being sold at the rate of 1000 per month.

Use of lighting kits and demonstrators by well-trained Better Sight salesmen is growing tremendously. It is known that approximately 3000 sets of this equipment have been sold in the last year to utilities alone by three electrical manufacturers. Hundreds of others, homemade, have been put to use.

Reliable sources estimate that over 5,000,000 column inches of newspaper advertising was used in 1934 on Better Light-Better Sight. This is from five to ten times the space formerly devoted to lighting. This advertising, appearing in every important city in the United States, and in the large majority of cities and towns over 3000 population, represents approximately 175,000 newspaper advertisements, with a circulation to over 40,000,000.

More than 175 pages of trade paper advertising were run in electrical, paint and optical publications.

In over 20 of the leading national magazines, including *The Saturday Evening Post, Ladies' Home Journal, Good Housekeeping, McCall's, Parents, Pictorial Review, Better Homes and Gardens,* and others of like character, have been run one or more page advertisements to a circulation of over 35,000,000.

More than 4,000,000 column inches of editorial articles have appeared in national magazines and in local newspapers throughout the country.

Over more than 40 radio stations of the country, electric utilities have broadcast the Better Light-Better Sight message to millions of listeners through many programs.

More than 10,000,000 pieces of direct mail material of various kinds are estimated to have been mailed and distributed by members of the electrical, optical and paint industries.

More than 100,000 window and interior display cards of many designs and sizes have been used by members of these three groups.

Thirty-two thousand Portable Lamp Selection Guides have been distributed.

Twenty-one thousand folders, "How to Sell the New I. E. S. Study and Reading Lamp," have been distributed.

o o o

So many local situations are carrying on the year's Better Light-Better Sight activities through to this spring that no effort has yet been made to collect country-wide data as to actual and net results secured from the 1934-35 fall and winter periods. Such a compilation nationally will be made in March and appear in the April issue of the *Better Light-Better Sight News.*

Those utilities and local Better Sight groups that have voluntarily sent in information on last fall's activities to the National Better Light-Better Sight headquarters have reported without exception highly successful and profitable operations.—G. T.

Use of Electric Power in Production Operations

In the Oil Fields of the Texas and Louisiana Gulf Coast Section

By E. P. Hubbard

Assistant Superintendent of Production, Gulf Production Company, Houston, Tex.

A paper presented at the Sixth Annual Conference of the Petroleum Electric Power Club
Dec. 4-6, 1934, Beaumont, Texas

THE subject assigned is one about which volumes might be written, but this paper is to be limited to a general discussion of the application of electric power in the oil fields of the Texas and Louisiana Gulf Coast Section.

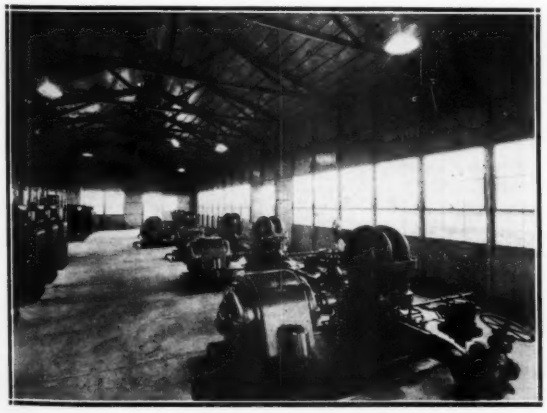
Prior to 1920 the use of electric power in the oil fields was sporadic. Beginning at this time, however, a general movement began to equip new fields for electric operation, and to convert old fields from gas and steam engine to motor drive. The price of oil reached a high point of $3 per barrel. The news spread that, by the use of electric motors, production could be increased from 10 to 15 per cent. In many of the fields the gas production had declined to a point where the fuel oil requirements represented nearly 9 per cent of the total production. In the space of about four years five power plants were put in operation by the oil companies for the sole purpose of operating their producing properties with electrical equipment. You gentlemen of the utilities, ably abetted by the electric equipment manufacturers, were quick to realize the potentialities of this new type of load, and a network of transmission lines began to take shape, and today it is conservatively estimated that 90 per cent of the oil-producing operations in the Texas and Louisiana Gulf Coast are served by the public utilities.

In this section there are approximately 3000 wells, of which 1250 are flowing, and 1750 are being produced on the pump. While no accurate data are available, it is estimated that these wells require an average of 15,000 kilowatts for their pumping and auxiliary operations. Annually the producing fields consume electric power to the tune of one and one-quarter million dollars, which comes under the head of "important money." In addition to the highly important revenue factor, the oil field power requirements afford a base load of considerable value to the operation of power plants and transmission systems. The load factor is probably considerably higher than any other type of load. No doubt many communities, irrigation plants, etc., owe the availability of electricity for their operations to the proximity of transmission lines built primarily to serve the oil fields. Since the world's bubble burst in 1929 the petroleum industry has experienced sharp curtailment in its production operations, notably in the pumping classification, but it is doubtful if their reduction in power requirements has been nearly so drastic as that experienced by other industries.

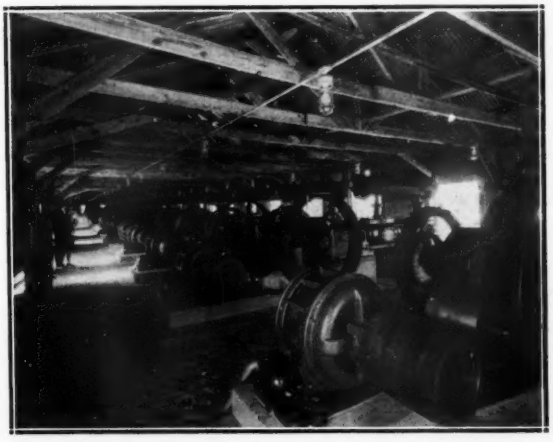
Whenever a producer adopts the use of electrical energy in any given field the application is generally 100 per cent. The drilling rig is usually the only exception, and many companies operate motor-driven rigs. A typical distribution of the energy consumed would be as follows:

Pumping Wells.....	65%
Gathering Pumps.....	20%
Drilling Rigs.....	4%
Fresh Water Supply...	4%
Miscellaneous	7%
	100%

In the Gulf Coast territory the load requirements for the average pumping well is approximately 6 kw. The range is from 1.5 kw per well operated by



Above—Typical 500-hp oil pipe line pumping station with one 250-hp motor-driven centrifugal pump as standby. This type of pump station is capable of delivering 30,000 bbl per day against 800 lb initial pressure.



Right—Typical gas lift station where the gas is compressed from approximately atmospheric pressure of about 300 lb to flow oil either through the tubing or in the annular space in the well in lieu of pumping with reciprocating pump.

The station shown on the photograph contains 24 100-hp motor-driven compressors, each compressor capable of delivering 400 CFM, two-stage to 300 lb.

central powers to about 15 kw for some of the deeper and heavier water wells. In some of the Edwards lime and woodbine sand fields these figures will reach 50 kw per well. In the Gulf Coast an average of about five barrels of water is lifted for each barrel of oil recovered on the pump. During the palmy days one of the prime advantages of electric equipment was its ability to maintain 97 per cent continuity of operation on pumping wells. Due to proration and other causes, the average hours operated per day per well reached a minimum of about 17. An encouraging note is sounded in that this figure has now increased to about 22 hours per day. Not all of this increase can be attributed to increased production, as some of the changes are due to fitting the operation and equipment so as to produce the same volumes over a longer period of time, thus improving load factor and reducing the load on the equipment.

The term gathering pumps is applied to all field pumps used for the transfer of production from the lease to the main pipe line storage. Included are pumps used to transfer production from the lease tanks to central dehydrating plants, pumps used to "pick-up" oil or water from firewalls and sumps, and pumps used for delivering oil from lease tanks and treating plants to the pipe line storage. The first two classes are usually classified as low pressure pumps with loads ranging between 5 and 25 hp, while the last-named are high-pressure pumps usually loaded from 25 to 50 hp. These pumps ordinarily operate from five to seven hours per day.

Electric drilling rigs are not in such general use as other producing equipment. Their best application is in the proven fields where power lines are available. It is only occasionally that a wildcat is so favorably located as to have a source of electric power available. In such instances the saving in fuel is material, as it is often necessary to truck fuel over bad roads, and the savings made by the use of electricity are obvious. The connected load on a drilling rig for deep drilling is usually around 400 hp. This scales down to the lighter rigs for shallow drilling whose connected load may be only 100 hp. The power consumption varies with the depth, formation, and speed of drilling and for this reason it is difficult to state any very definite figure. Nine hundred-foot wells have been drilled with a minimum of 2000 kwhr, or about 2 kwhr per foot. Seven thousand-foot wells have been drilled with a maximum of 210,000 kwhr, or about 30 kwhr per foot. A general average of 4000 ft. for 20 kwhr per foot should serve as a close approximation. As a general rule the pumps require 65 per cent of the total power, with the remaining 35 per cent used by the rotary and hoist.

The foregoing accounts for approximately 90 per cent of the power used in the field. The remaining 10 per cent is used by the various auxiliaries such as fresh water pumps and compressors, waste water disposal, electric dehydrators, shops, and general cottage and field illumination.

It is conservatively estimated that the field lines, transformers, and motors in use in the Coastal fields represent an investment by the producing companies of $10,000,000, and that the gross revenue to the utilities will exceed $1,250,000 annually. The oil producers and the utilities are not only linked financially, but from an operating standpoint that vital factor—source of power—is in your hands. Thus your problems are ours and our problems are yours. You have a service to sell to the petroleum industry, and, rightfully, the burden of the proper solution rests with you. The operator, however, should accept the responsibility of properly outlining his problems and proffer his experience and counsel.

There are many problems of varying degrees in importance worthy of consideration. To three of these your attention is particularly directed: first, distribution voltage; second, contracts; and, third, rate schedules. Many oil companies operate in more than one field, and often are served by more than one utility company. They encounter field distribution voltages ranging from 2300 volts to 13,200 volts. The effects are obvious. It is believed that steps are being taken to remedy this condition, and you are urged to reach a conclusion and adopt a standard distribution voltage. A great many contracts are signed over the protest of legal counsel. It is felt that the utilities, in their zeal to safeguard their interests from every conceivable angle, insert clauses and phrases which are burdensome to the consumer. The solution of this problem should be easy; it is only necessary that the buyer and seller mentally reverse their positions and ask no more than they would be willing to concede if their positions were actually reversed. After all, a contract is a "fifty-fifty" agreement. Probably no one problem has been so much the subject of discussion as "Rate Schedules." Any fair-thinking man recognizes and appreciates the complexities that attend the construction of workable schedule of rates; there is no question but that an expert specialist is required. This suggestion is offered. Perhaps the present schedules are an outgrowth of ideas originated with the first sale of power and expanded, changed, and adapted to meet new conditions as they presented themselves. Naturally the fundamentals must remain, but suppose we discard the superstructure built to accommodate the steel, mining, irrigation, or what-have-you industry, and on the basic foundation erect a rate schedule particularly adapted to the petroleum-producing industry. The Petroleum Electric Power Club provides a powerful means of designing and promulgating uniform schedules on which the oil producer may purchase power wherever he may be.

In conclusion, I believe I am taking no undue liberty in expressing the appreciation of the oil producers for the whole-hearted cooperation which the utilities have extended us in every phase of our relationship.

Architects to Compete in Small Home Designs

COOPERATING with the Federal Housing Administration and to stimulate interest in small home building, Gerard Swope, president of the General Electric Company, has announced that his company will sponsor a national competition, beginning Jan. 1, 1935, among architects for designs of small homes that will provide the utmost in modern convenience and livability.

A total of 54 prizes, aggregating $21,000, will be offered to architects and designers. It will be possible for one architect to win awards amounting to $5,000. Demonstration homes will later be constructed in various parts of the country.

"This competition will enable the public to get a new vision of what an inexpensive home can be like in this new era of our national development," Mr. Swope said. "Science has made great strides in home electrification even through the depression years. There is no longer any need for the homemaker to tire herself out with household labor. Most of it can be done more simply,

(Continued on page 32)

Schedule of Preferred Ratings for Oil Circuit Breakers

AT the latest meeting of the EEI-AEIC-NEMA Joint Committee* on Oil Circuit Breakers, the NEMA representatives presented a revised Schedule for Indoor and Outdoor Oil Circuit Breakers. Basically, it is the same as the EEI-AEIC-NEMA Joint Committee's earlier schedule (published in N.E.L.A. BULLETIN, November, 1931, page 759) but with improvements in the form of presentation and a few changes in the short time ratings. Tables I and II present the new set-up, which was found to be generally acceptable to the operating company representatives. These tables are on the two pages immediately following.

Inasmuch as all breakers are now rated on a constant kv-a basis, the NEMA listings no longer carry ampere interrupting ratings at voltages below the rated voltages of the breaker. Instead there has been added a maximum interrupting rating which indicates the maximum current to which the breaker should be subjected from an interrupting standpoint. This scheme of using the maximum ratings has simplified the interrupting rating tables; and has been found by those who are constantly making applications to be more readily usable than the older scheme of listing supplementary interrupting ratings at intermediate voltages.

This NEMA revised schedule contains several breakers not on the Joint Committees approval list. Since the manufacturers felt that these extra ratings were beneficial to certain sections of the industry, the Joint Committee agreed to ask NEMA to set up the complete revised schedule presented in Roman face type and the extra breakers in italics as shown in Tables I and II.

A resolution to reinstate the 350,000 kv-a interrupting rating in the 15 kv indoor class in the Schedule of Preferred Ratings was voted down. It was the consensus of opinion that the demand for this size breaker and the possible net cost advantages were not sufficient to justify inclusion of the 350,000 kv-a rating in a national standard. In coming to this conclusion, the Joint Committee gave very careful consideration to the following items:

1. The estimated requirements of those operating companies who expressed an interest in the insertion of the 350,000 kv-a rating.
2. The costs involved in using the 500,000 kv-a rating instead of the 350,000 kv-a.
3. The size of present cell structures.
4. The size of the new breakers.
5. And finally, the increase in costs which would be reflected back on the other ratings because of a decrease in demand for the present standard breaker if the new ratings were inserted in the schedule.

* A joint committee sponsored for the E.E.I. by the Electrical Equipment Committee—G. Sutherland, chairman for E.E.I.

Experimental Investigation of Self-Shielding of Telephone Cables

ENGINEERING Report No. 26,* "Shielding of Ground Return Circuits at Low Frequencies," covers rather completely the shielding of telephone circuits from induction at fundamental frequency of power systems, except for certain aspects of the self and mutual shielding of conductors in cable. Computations indicated that on full-size toll cable the shielding from this source might be substantial, but due to the complexity of exact calculations, and the lack of experimental data, this section of the report is of necessity incomplete. To fulfill this lack of experimental data, and to round out the subject of shielding, a field investigation has been undertaken on a 50-mile section of the toll cable between Greenville, S. C., and Atlanta, Ga.

The construction of the cable has been completed, but since it has not yet been put into commercial operation it presented an opportunity of studying shielding of such a cable under controlled conditions. Through the cooperation of the Long Lines Department of the A. T. & T. Company a section of this cable was put at the disposal of the Joint Subcommittee on Development and Research for these tests. With the exception of about five miles of underground construction in Greenville, and a much shorter section at the other end, the cable section under test is aerial throughout. The cable has 308 pairs of 19-gauge conductors, segregated for four-wire operation.

One reason for selecting this particular section of cable was that there were no exposures of any importance to other circuits, and the stray voltages on the cable were therefore small. Controlled values of induced voltages along the cable were secured by constructing ground return circuits which could be energized from low-voltage sources. These circuits consisted of bare wire carried on the cable poles. To permit a study of voltage distribution along the cable two exposures were constructed—one near the center of the line, and the other at one end.

This cable is kept under a pressure of nitrogen gas, and two control pairs are brought out at distances of approximately three miles. One pair is connected to a gas-pressure gauge to sound an alarm in case of low pressure, and the other is provided for communication. The availability of these pairs made possible the measurement of currents and voltages at several points along the line, and in a number of instances they were used as leads to transmit the quantities to be measured to the instruments which were located at either end of the cable. For the purpose of these tests additional pairs were brought out of the cable near its center, and at the ends of the aerial sections. Insulating joints were inserted in the cable sheath at the beginning of the underground sections, and also near the center of the section, thus permitting the sheath to be sectionalized and isolated from ground.

The magnitude of self-shielding is, among other factors, dependent upon the termination of the conductors, whether isolated, grounded or connected to terminal apparatus which has a grounded point, such, for instance, as telegraph composite sets. It is obviously impossible to investigate experimentally all the combinations of circuits and ter-

(*Continued on page* 32)

*Engineering Report No. 26 of the Joint Subcommittee on Development and Research of the E.E.I. and Bell System was formerly Technical Report 2K-2 and under that designation was described in the Jan., 1934 issue of the E.E.I. BULLETIN.

STANDARD OIL CIRCUIT BREAKER RATINGS

TABLE I—OUTDOOR BREAKERS

The standard interrupting ratings, 60 cycle ampere ratings, and short time ampere ratings for oil circuit breakers and metal clad switchgear shall be as follows:

Nominal System Voltage	*Oil Circuit Breaker Rated Voltage*	*Rated Amperes*	*Interrupting Rating Kva.***	*Short Time Rating R.M.S. Total Amperes*		*Interrupting Ratings In R.M.S. Total Amps.****	
				One Second	*Five Seconds*	*Maximum Rating*	*At Rated Voltage*
6,600	*7,500*	*400*	*50,000*	*20,000*	*15,000*	*12,000*	*4,000*
6,600	*7,500*	*600*	*50,000*	*25,000*	*20,000*	*12,000*	*4,000*
13,200 (1)	15,000	600	50,000	40,000	30,000	12,000	2,000
	15,000	600	100,000	40,000	30,000	24,000	4,000
	15,000	600	175,000	40,000	30,000	40,000	7,000
	15,000	1,200	175,000	40,000	30,000	40,000	7,000
	15,000	600	500,000 (3)				
	15,000	1,200	500,000 (3)				
	15,000	2,000	500,000 (3)				
	15,000	1,200	1,000,000 (2)	80,000	60,000	80,000	40,000
	15,000	2,000	1,000,000 (2)	100,000	100,000	80,000	40,000
	15,000	3,000	1,000,000 (2)	100,000	100,000	100,000	40,000
	15,000	2,000	1,500,000 (2)	100,000	100,000	100,000	60,000
	15,000	3,000	1,500,000 (2)	120,000	120,000	100,000	60,000
	15,000	4,000	1,500,000 (2)	120,000	120,000	120,000	60,000
22,000	23,000	600	150,000	40,000	30,000	7,500	4,000
	23,000	600	500,000	50,000	30,000	40,000	12,500
	23,000	1,200	500,000	60,000	50,000	50,000	12,500
	23,000	2,000	500,000	60,000	60,000	60,000	12,500
	23,000	1,200	1,000,000 (3)				
	23,000	2,000	1,000,000 (3)				
	23,000	3,000	1,000,000 (3)				
	23,000	1,200	1,500,000 (3)				
	23,000	2,000	1,500,000 (3)				
	23,000	3,000	1,500,000 (3)				
33,000 (1)	34,500	600	150,000	40,000	30,000	4,000	2,500
	34,500	600	500,000	50,000	30,000	12,500	8,400
	34,500	1,200	500,000	60,000	50,000	12,500	8,400
	34,500	2,000	500,000	60,000	60,000	12,500	8,400
	34,500	1,200	1,000,000	60,000	60,000	25,000	17,000
	34,500	2,000	1,000,000	60,000	60,000	25,000	17,000
	34,500	3,000	1,000,000	80,000	80,000	25,000	17,000
	34,500	1,200	1,500,000	60,000	60,000	40,000	25,000
	34,500	2,000	1,500,000	60,000	60,000	40,000	25,000
	34,500	3,000	1,500,000	80,000	80,000	40,000	25,000
44,000	46,000	600	150,000	20,000	20,000	3,000	2,000
	46,000	600	500,000	20,000	20,000	10,000	6,300
	46,000	1,200	1,000,000 (†)	30,000	20,000	20,000	12,500
66,000 (1)	69,000	600	250,000	20,000	20,000	4,200	2,100
	69,000	600	500,000	20,000	20,000	8,400	4,200
	69,000	600	1,000,000 (†)	30,000	20,000	17,000	8,400
	69,000	1,200	1,000,000 (†)	30,000	20,000	17,000	8,400
	69,000	600	1,500,000 (†)	50,000	30,000	25,000	12,500
	69,000	1,200	1,500,000 (†)	50,000	30,000	25,000	12,500
	69,000	1,200	2,500,000 (†)	60,000	40,000	42,000	21,000
	69,000	2,000	2,500,000 (†)	60,000	40,000	42,000	21,000
110,000	115,000	600	500,000	20,000	20,000	4,200	2,500
	115,000	600	1,000,000	30,000	20,000	8,400	5,000
	115,000	600	1,500,000 (†)	30,000	20,000	12,500	7,500
	115,000	1,200	1,500,000 (†)	30,000	20,000	12,500	7,500
132,000 (1)	138,000	600	750,000	30,000	20,000	4,700	3,200
	138,000	600	1,500,000 (†)	30,000	20,000	9,500	6,300
	138,000	1,200	1,500,000 (†)	30,000	20,000	9,500	6,300
	138,000	1,200	2,500,000 (†)	30,000	20,000	15,800	10,500
154,000	161,000	1,200	1,500,000 (†)	20,000	20,000	7,500	5,400
	161,000	1,200	2,500,000 (†)	20,000	20,000	12,500	9,000
220,000 (1)	230,000	1,200	2,500,000 (†)	20,000	20,000	9,000	6,300
330,000 (1)	345,000	1,200	3,500,000 (†)	20,000	20,000	9,000	6,000

STANDARD OIL CIRCUIT BREAKER RATINGS

TABLE II—INDOOR BREAKERS

The standard interrupting ratings, 60 cycle ampere ratings, and short time ampere ratings for oil circuit breakers and metal clad switchgear shall be as follows:

Nominal System Voltage	*Oil Circuit Breaker Rated Voltage*	*Rated Amperes*	*Interrupting Rating Kva.***	*Short Time Rating R.M.S. Total Amperes*		*Interrupting Ratings In R.M.S. Total Amps.****	
				One Second	*Five Seconds*	*Maximum Rating*	*At Rated Voltage*
2,300 (1)	2,500	200	10,000 (4)	* 50	* 25	8,000	2,400
4,000 (1)	5,000	400	20,000 (4)	15,000	10,000	12,000	2,400
	5,000	600	50,000 (3) (†)				
	5,000	1,200	50,000 (3) (†)				
	5,000	2,000	50,000 (†)	40,000	40,000	20,000	6,000
	5,000	*2,000*	*50,000* (4)	*40,000*	*40,000*	*20,000*	*6,000*
6,600	7,500	600	25,000 (4)	20,000	20,000	20,000	2,000
	7,500	600	50,000 (3) (†)				
	7,500	*1,200*	*50,000* (4)	*35,000*	*35,000*	*20,000*	*4,000*
	7,500	1,200	50,000 (†)	40,000	40,000	20,000	4,000
	7,500	600	100,000 (†)	50,000	30,000	30,000	8,000
	7,500	1,200	100,000 (3) (†)				
13,200 (1)	*15,000*	*600*	*50,000* (4)	*25,000*	*25,000*	*20,000*	*2,000*
	15,000	600	50,000 (†)	40,000	30,000	20,000	2,000
	15,000	600	100,000 (†)	50,000	30,000	30,000	4,000
	15,000	1,200	100,000 (†)	60,000	50,000	30,000	4,000
	15,000	600	150,000 (†)	50,000	30,000	36,000	6,000
	15,000	1,200	150,000 (†)	60,000	50,000	36,000	6,000
	15,000	600	250,000 (†)	50,000	30,000	50,000	10,000
	15,000	1,200	250,000 (†)	60,000	50,000	60,000	10,000
	15,000	2,000	250,000 (†)	70,000	60,000	60,000	10,000
	15,000	600	500,000 (†)	50,000	30,000	50,000	20,000
	15,000	1,200	500,000 (†)	60,000	50,000	60,000	20,000
	15,000	2,000	500,000 (†)	80,000	80,000	80,000	20,000
	15,000	1,200	1,000,000 (†) (2)	80,000	60,000	80,000	40,000
	15,000	2,000	1,000,000 (†) (2)	100,000	100,000	100,000	40,000
	15,000	3,000	1,000,000 (†) (2)	100,000	100,000	100,000	40,000
	15,000	1,200	1,500,000 (†) (2)	100,000	80,000	100,000	60,000
	15,000	2,000	1,500,000 (†) (2)	100,000	100,000	100,000	60,000
	15,000	3,000	1,500,000 (†) (2)	120,000	120,000	120,000	60,000
	15,000	4,000	1,500,000 (†) (2)	120,000	120,000	120,000	60,000
22,000	23,000	600	500,000 (†)	50,000	30,000	25,000	12,500
	23,000	1,200	500,000 (†)	60,000	50,000	25,000	12,500
	23,000	2,000	500,000 (†)	60,000	60,000	25,000	12,500
	23,000	1,200	1,000,000 (3) (†)				
	23,000	2,000	1,000,000 (3) (†)				
	23,000	1,200	1,500,000 (3) (†)				
	23,000	2,000	1,500,000 (3) (†)				
	23,000	3,000	1,500,000 (3) (†)				
	23,000	2,000	2,500,000 (3) (†)				
	23,000	3,000	2,500,000 (3) (†)				
33,000 (1)	34,500	600	500,000	50,000	30,000	12,500	8,400
	34,500	1,200	1,000,000 (†)	60,000	60,000	25,000	17,000
	34,500	2,000	1,000,000 (†)	60,000	60,000	25,000	17,000
	34,500	1,200	1,500,000 (†)	60,000	60,000	40,000	25,000
	34,500	2,000	1,500,000 (†)	60,000	60,000	40,000	25,000
	34,500	3,000	1,500,000 (†)	80,000	80,000	40,000	25,000
	34,500	2,000	2,500,000 (†)	80,000	80,000	65,000	42,000
	34,500	3,000	2,500,000 (†)	100,000	100,000	65,000	42,000

(1) These nominal system voltages and corresponding oil circuit breaker rated voltages are those preferred for new undertakings and indicate the suggested trend for future practice.

(2) These breakers to be insulated to stand A.I.E.E. standard tests specified for 23,000 volts.

(3) There are no breakers of this rating; use breakers in the next higher voltage class for application at these voltages.

(4) Non-oil-tight breakers.

† Ratings applicable to both indoor or outdoor oil circuit breakers and either indoor or outdoor metal clad switchgear.

* Times coil rating. Interrupting rating of series trip breakers must not exceed momentary rating, regardless of voltage.

** The Kva. rating is based on the interrupting rating in amperes at rated voltage multiplied by this voltage and by the square root of three.

*** To obtain the ampere interrupting rating of a breaker for use on a system of less than the rated voltage, the following formula should be used:

$$\text{Amperes at system voltage} = \text{amperes at rated voltage} \times \frac{\text{Rated volfage}}{\text{System voltage}}$$

If the value so calculated exceeds that given in the Column "Maximum Rating," then the maximum rating must be used as the interrupting rating of the breaker.

Footnotes apply to both Tables I and II

INDUSTRIAL HEATING POINTERS

WINTER HEATING SUGGESTIONS

The winter season always brings a number of heating problems to our customers, and electric heat usually offers the best solution. Sprinkler valve houses need protection from freezing, pumping stations must have some heat to protect them from the winter weather, viscous liquids are often stored in tanks, and their withdrawal is a problem until heat steps into the picture. Organ lofts and similar locations require a safe, clean, quiet heat, and so many other places could make economic use of electric heat that it is impossible to even attempt to list them here.

This is the time of year to win favor with your customers by helping them with these sometimes small but very perplexing problems. A canvass of every one of their plants would not be amiss to find the cold corners and other bad conditions that, while existent in the past, are decidedly not necessary or in keeping with our present ideas of production, health, and comfort. Don't let these little jobs slide, as they are one of your best means of winning your customer's appreciation and cooperation for future and larger jobs.

Equipment available today for solving these problems is so complete and extensive that little or no time should have to be spent on the technicalities that we have so often allowed to defeat the sale of this equipment. Don't forget our old friend "soil heating cable" in going after your heating problems. This versatile helper is certainly the answer to a power salesman's prayer.

ANODIC OXIDATION PROCESS

Recent developments in the anodic oxidation process of coating aluminum are of interest to electrical engineers. A durable finish, many times thicker than the oxide film formed on aluminum by nature, may be obtained.

The oxide coating is ordinarily translucent and, when formed on commercially pure aluminum sheet, does not conceal the natural metallic luster of the metal. Certain metallic constituents of aluminum alloys, such as silicon for example, have a tendency to change the hue of the coating. Silicon imparts a darker cast to the coating, and in castings containing substantial amounts of that metal it may produce a brownish black coating.

The physical condition of the metal, particularly as determined by surface preparation, effects varying degrees of luster on the finished product.

The oxide coating is produced by making the article to be treated the anode, or positive terminal, in a sulphuric acid bath of special composition and passing a direct current of approximately fifteen amperes per square foot of surface through the material at a line potential of 15 to 25 volts. This current is sustained for 20 to 40 minutes, depending upon the type of surface to which the article is to be subjected. The cathode or negative terminal is the lead-lined wall of the treatment tank.

Coatings may be produced of high corrosion and abrasion resistance; they may be made impervious or absorptive. Coatings may also be made with excellent dielectric characteristics.

The ability to make absorptive coatings increases the versatility of anodized aluminum. The color is applied by immersing the coated article in an aquean solution of organic or inorganic coloring materials, and so great are the possibilities that any color of the rainbow can be reproduced.

A sealing process applied to both uncolored and colored coatings further protects the metal and prevents the coating from being stained by foreign substances. Thus soot, dirt, grime, oil, or the marks of fingerprints do not mar the even tone of the finish. It can be cleaned by a rag dampened with water or organic solvents such as gasoline, kerosene, or turpentine.

To date this coating has been applied to such commodities as window frames, spandrels, escalators, and other types of architectural aluminum. Its purpose in this field is both decorative and protective. The anodic coating of ice cube trays is so prevalent as to be considered almost standard. Millions of these trays are in use today.

Automotive pistons treated in this manner have a greater surface hardness and are able to resist abrasion much better than pistons which do not have this protective coating. Other commodities frequently anodized include novelties, compacts, lipstick holders, cigarette trays and cases, cocktail sets, fishing reels and pole handles, automatic pencils, nameplates, etching plates, hand rails, stirrups, tooth brush handles, cast ornaments, statuary, vacuum cleaner parts and washing machine agitators.

The process started with the installation of a 1000 ampere unit. This company has now installed an additional 2000 ampere unit. These units are run about ten hours per day.—M. R. McCONNELL, West Penn Power Company.

ELECTRICALLY HEATED VACUUM STILL

A chemical plant manufacturing thinners for lacquers was experiencing difficulty with a 500 gallon vacuum still heated by gas. The product had two undesirable characteristics; namely, an odor and a cloudy appearance.

In recommending electric heat for this process the method of applying heat had to be such as to produce better temperature control and without the danger of reaching the flash point of the solvents.

The final design adopted consisted in the application of clamp-on heaters to the sides and bottom of the kettle with zone control for two tiers of heaters and the bottom. Insulation on the outer shell with connections at the top of kettle to a vacuum and condenser completed the installation.

The desired product is being produced in this 500 gallon kettle in less time than was formerly possible, with a greater degree of safety with an input of about 75 kw.

A duplicate still is now under consideration for the same kind of work.—MAXWELL COLE, Philadelphia Electric Company, Philadelphia, Pa.

ELECTRIC FURNACES

A foundry has installed a 250 kv-a, 3 phase melting furnace to be used in the manufacture of piercing balls for seamless tubes. These balls were formerly made in gas fired crucibles, but through the use of the electric furnace, their life will be greatly increased, due to their being alloyed at a temperature of 3500 deg. F.

A large steel fabricating company has converted a combination gas and electric furnace into an all electric furnace used in applying lead binder to steel sheets. The load in this case is 36 kv-a.

A 5 kv-a air flow electric furnace has been installed by a casket manufacturing company to dry the glue used in holding the lining to the casket frame. The casket is placed in a short tunnel of rectangular cross section. A blast of hot air from the heating units is passed through the tunnel.

A 13 kv-a electric furnace has replaced oil fired furnaces used in the manufacture of dental supplies.—J. J. TENNANT, Duquesne Light Company.

POWER SALES ITEMS

ACCOUNTING

"Why Not Uniform Accounting by Public and Private Plants?" by H. S. Chase. Public Utilities Fortnightly, Dec. 6, 1934, p. 727. Public Utilities Reports, Inc., Publishers, Munsey Building, Washington, D. C.

Otherwise, comparisons of utility rates are futile and deceptive and correct analysis and comparison of the efficiency of government and private plants impossible.

AIR CONDITIONING

"Air Conditioned Test Home." Electrical Merchandising, December, 1934, p. 3. McGraw-Hill Publishing Co., Inc., 330 West 42nd Street, New York City.

House built by Electrical Testing Laboratory gives opportunity to study all phases of air conditioning.

"Air Conditioning Applications." Forbes, Dec. 15, 1934, p. 12. B. C. Forbes Publishing Co., Inc., 120 Fifth Avenue, New York City.

Applications in various industries and advantages discovered.

COMMERCIAL METHODS

"Better Letters," by R. C. Cox. American Gas Association Monthly, November, 1934, p. 397. American Gas Association, Publishers, 420 Lexington Avenue, New York City.

The courtesy, understanding, and intelligence, or the reverse, of every letter sent to customers by a public utility company influences the customers opinion of that company.

DIESEL ENGINES

"Culpeper, Va., Installs Municipal Diesel Light Plant," by Edgar B. Boynton. Diesel Power, January, 1935, pp. 22-29. Business Journals, Inc., Publishers, 192 Lexington Avenue, New York City.

The first municipal power plant completed under the Public Works Administration was put into operation in August, 1934, at Culpeper, Va. The equipment consists of three Diesel engines, with all accessories necessary to obtain reliable and economical power. The plant and distribution system was formally dedicated on Oct. 18, 1934, in the presence of a large group of prominent National and State figures.

"Ohio's Finest Municipal Diesel Plant," by L. H. Morrison." Diesel Power, December, 1934, pp. 667-670. Business Journals, Inc., Publishers, 192 Lexington Avenue, New York City.

Oberlin, home of one of America's great musical conservatories, has built the most attractive and best designed Diesel light plant in Ohio, if not in the entire country.

"Quick Pay-Out for the Diesel Electric Plant," by Edgar J. Kates. Diesel Power, December, 1934, p. 672. Business Journals, Inc., Publishers, 192 Lexington Avenue, New York City.

The author recommends against cutting investment costs through cheapening or eliminating accessories. States best way to reduce cost is through reducing engine capacity. Peak load deficiencies can then be made up by purchase under a standby contract. Example is cited.

ECONOMICS

"Fifty Per Cent of Power Dollar Wasted." Power, Mid-December, 1934, p. 704. McGraw-Hill Publishing Co., Inc., 330 West 42nd Street, New York City.

Survey conducted in 454 plants shows that obsolete equipment, poor working schedules, etc., waste 50 cents out of every dollar spent for power.

ELECTRIC FURNACE

"Electric Furnace Application." Steel, Dec. 3, 1934. The Penton Publishing Company, Penton Building, Cleveland, Ohio.

Data showing that electric furnace is best for high test cast iron.

ELECTRIC HAMMER

"Electric-Air Hammer Economy," by R. C. Grimstad and F. A. Kolb. Electrical World, Nov. 24, 1934, p. 33. McGraw-Hill Publishing Co., Inc., 330 West 42nd Street, New York City.

The authors of this article have outlined the installation of a large air compressor for converted forge hammers. The air compressors took the place of steam and resulted in a saving of $8,000 yearly on an investment of $17,000. This article shows how Industrial Engineers, Utility Power Salesmen and Manufacturers' Salesmen can sell modernization in industry.

ELECTRIC MOTORS

"High Speed News Printing," by W. L. Wright. Electrical World, Dec. 22, 1934, pp. 30-32. McGraw-Hill Publishing Co., Inc., 330 West 42nd Street, New York City.

Power sales engineers and manufacturers will find this article of interest, as the use of high speed motors such as applied to news printing could be used in other manufacturing processes. The writer of this article describes the use of induction type Selsyn unit built integral with the driving motors of a high speed newspaper press.

EQUIPMENT

"New and Improved Equipment." Power, Mid-December, 1934, p. 733. McGraw-Hill Publishing Co., Inc., 330 West 42nd Street, New York City.

Twenty-eight pages of new and improved equipment, most of it run by electricity.

GROUP DRIVE

"Mechanical Power Transmission." Chemical & Metallurgical Engineering, December, 1934, p. 624. McGraw-Hill Publishing Co., Inc., 330 West 42nd Street, New York City.

Choice and method of mechanical power transmission in the process industries; also discussing group vs. individual drive.

HEAT BALANCE

"Brewer Betters Heat Balance," by Charles Stoeckly. Electrical World, Nov. 10, 1934, pp. 36-37. McGraw-Hill Publishing Co., Inc., 330 West 42nd Street, New York City.

Industrialists who are studying to improve their heat balance and power sales engineers who work out interconnections with large process steam users will find some pertinent information to their problems in this article. This splendid article should give power sales engineers, industrial engineers and manufacturers some new ideas on sales approach for brewery plants and other similar industries where maintaining a heat balance is an economical problem.

POWER CONTRACTS

"When You Renew Your Industrial Power Contracts—a Huddle May Help." Power, December, 1934, p. 664. McGraw-Hill Publishing Company, Inc., 330 West 42nd Street, New York City.

Wherein is suggested a list of questions which should be discussed with the power salesman; article also suggests that if Management is not capable of meeting the salesman on equal terms, a consultant should be retained.

POWER FACTOR

"Savings Recover Motor Cost," by C. B. Schafer and W. V. Gorton. Electrical World, Dec. 8, 1934, p. 33. McGraw-Hill Publishing Co., Inc., 330 West 42nd Street, New York City.

In this article the authors discuss the correction of power factor and cite some of the savings that can be expected when proper corrected installations are made. Many industrial concerns are considering new equipment and the matter of power factor correction in this connection is of increasing importance. The power sales engineers and manufacturers' representatives can be of valuable service as pointed out in this article.

POWER SALES

"Power-Sales Results and Trends." Electrical World, Jan. 5, 1935, p. 57. McGraw-Hill Publishing Co., Inc., 330 West 42nd Street, New York City.

Achievements in some industrial territories —Where the new business is coming from —How utilities have reorganized for developing usage—Immediate markets available—Approach to untouched fields.

REVERSING DRIVES

"High-Speed Reversing Drives," by H. S. Stewart. Electrical World, Nov. 10, 1934, p. 30. McGraw-Hill Publishing Co., Inc., 330 West 42nd Street, New York City.

Many industrial plants have operations which require return movement of machines after a working stroke which, if speeded up, can increase the productive capacity of the machine. The author in this article discusses the development of high speed reversing drives and suggests future developments in similar applications. Power sales engineers, factory superintendents and industrial consultants will find something new and of interest in this item of industrial news.

Memorial to the President

(*Continued from page 4*)

These opinions are in no wise finally controlling, but they at least create a background of serious doubt. I assume that there is no one more interested than the Government in having finally settled as soon as possible the constitutionality or legality of projects upon which it is proposed to spend hundreds of millions of dollars, as to the legality of which such a doubt exists. I respectfully urge that parties interested and the Government unite in taking such proceedings as will bring about a decision of the highest court in the land upon the question at the earliest moment possible. The Institute itself is not desirous of becoming a party to litigation with the Government, if indeed its status would enable it to do so, but its officers and trustees realize that in their respective companies they are trustees for all these employees and investors to whom reference is made in the earlier part of this statement, whose rights are entitled to protection.

THOMAS N. MCCARTER,
President, Edison Electric Institute.

Architects to Compete

(*Continued from page 26*)

efficiently, and less expensively by electrical servants. Washing, ironing, sweeping, cooking, and washing the dishes can be done electrically at little cost. Great improvements have taken place in home lighting. The toilsome, troublesome heating problem has been solved, and air conditioning has arrived to make the home healthier, cleaner, more comfortable the year around.

"All of the new advances in the art of living should be made available to everybody, and we are confident the architects of the country will be able to show in their designs just how this is to be done in the small homes."

The project has been approved by the Federal Housing Administration and the Bureau of Home Economics of the U. S. Department of Agriculture, the American Institute of Architects, and the National Association of Real Estate Boards will cooperate in its conduct. J. F. Quinlan, General Electric Company, New York, has been named as director of the competition, with Kenneth K. Stowell, editor of the *Architectural Forum,* as professional adviser. Mr. Quinlan was secretary of Light's Golden Jubilee Committee in 1929.

CONTENTS OF THIS ISSUE

The Electric Light and Power Business at the Beginning of Another Year — *By Thomas N. McCarter* 1
A Memorial to the President of the United States 3
Canada's High Domestic Consumption — *By William M. Carpenter* 5
Government Competition with Electric Utilities — *By Paul S. Clapp* 9
Making Rural Electrification Pay — *By G. C. Neff* 13
More Elbow Room — *By Wills Maclachlan* 16
Hurdles for 1935 — *By C. E. Greenwood* 17
Hydro Station Operation with Minimum Loss — *By S. O. Schamberger* 19
A First of the Year View of National Better Light—Better Sight Activities 21
Use of Electric Power in Production Operations — *By E. P. Hubbard* 25
Architects to Compete in Small Home Designs 26
Schedule of Preferred Ratings for Oil Circuit Breakers 27
Experimental Investigation of Self-Shielding Telephone Cables 27
Industrial Heating Pointers 30
Power Sales Items 31

CONVENTIONS AND MEETINGS

JANUARY

10-12 American Engineering Council, Washington, D. C.
14-15 Prime Movers Committee, Hotel Statler, Detroit, Mich.
22-25 American Institute of Electrical Engineers, New York, N. Y.

FEBRUARY

18-19 Electrical Equipment Committee, Netherland Plaza Hotel, Cincinnati, Ohio.

MARCH

19-22 Electrical Committee, National Fire Protection Association, c/o Electrical Association of New York, 46th & Lexington Ave., New York, N. Y.

JUNE

19-21 The American Society of Mechanical Engineers, Hotel Gibson, Cincinnati, Ohio.

Self-Shielding Telephone Cables

(*Continued from page 27*)

minal equipment which are likely to be encountered on operating cables, and all that is being attempted is to determine the voltage distribution for certain limiting conditions, such as all conductors isolated or grounded, or connected to composite sets. Measurements are also being made with a few combinations of these conditions. In addition to measuring the distribution of voltage for different circuit arrangements, measurements will also be made of some of the impedances of the cable, to permit the comparison of computed and measured values of voltage appearing between the conductors and sheath. An agreement between the measured voltages, for the several conditions studied in detail, and computations using the impedance values of the particular cable will permit confidence in predicting voltages for other cables and combinations of circuits not specifically investigated.

From the standpoint of self-shielding, one of the important terminations is that of composite sets used for metallic telegraph. Before starting the field investigation impedance measurements were made on a number of types of telegraph equipment, and on several samples of each type. These measurements included an investigation of the variation of impedance with magnitude of voltage impressed across it, and the impedance variation with frequency. These data were then used in designing terminations to simulate any desired number of units of a particular type of terminal equipment.